EXECUTIVE SUMMARY

At the request of Mayor George Fitch, Antares performed a comprehensive feasibility study for a biomass to energy plant which would produce enough electricity and fuel from local wastes and residues to make Warrenton and even Fauquier County energy independent. It could be used as a template for other communities.

The study identified the types, quantities and locations of biomass feedstocks available within a 25 and 50 mile radius of Warrenton, such as municipal solid waste (MSW) and non recyclable commercial debris (C&D) at the landfill; as well as other non traditional feedstocks such as wood residues and used tires.

Key suppliers of the different feedstocks were contacted to obtain quantity and price information. With the assistance of Pacific Northwest National Laboratory (PPNL), different conversion technologies were examined to determine the best process to use for a small scale integrated biorefinery.

Based on the quantities and costs of these feedstocks, the size of the biorefinery would be small. It would have to rely on the MSW and C&D at the landfill to keep the feedstock costs to a minimum. The County receives a tipping fee of $46 per ton and the estimated avoidance cost for a waste to energy plant at its landfill is between $13 to $22 per ton. The landfill could provide the biorefinery with 250 to 300 tons per day of MSW and wood chips. The feedstock cost (fuel price) used in the economic analysis is a negative $13 per ton.

There are two cells from years of landfill burial that could be mined which would yield another 125 tons per day for 15 years. Additionally there are large quantities of woody residues and green wastes in the area that could be separately contracted. Also, there are 800 tons per month of used tires from the I-95 landfill nearby that could be made available.

In the neighboring county fifteen miles away, 320 tons per day of MSW is delivered to a transfer station. The tipping fee, all of which would be given to a local biorefinery sited next to the transfer station, is $40/ton. Additionally, there is 15,000 tons per day of woody biomass in the area. The average delivered cost at plant gate of these woody feedstocks is $23 per ton. As part of the Energy bill, there is a provision for a federal payment of $20 per ton for the use of wood residues for energy. (This provision might not remain in the final bill)

There are large quantities – at least 300,000 tons annually - of high moisture wastes such as sewer sludge and animal manures to be used for anaerobic digestion into a gas. The Biogas Production Incentives Act of 2007, currently being considered, would provide tax

credits, loans and grants and a floor price for biogas producers who use animal and other organic wastes.

The biorefinery should be sited at the landfill where the necessary infrastructure is in place. The County has one of the most advanced recycling operations with a brand new C&D separation and recycling plant. Methane gas is already being captured and converted into electricity for export to the grid. There is easy access to transmission lines and the grid. There is adequate water supply. The County has vacant land at or adjacent to the landfill that could be leased for a plant.

The use of agriculture residues such as corn stover and soybean stubble from the local farms is cost prohibitive. Farmers indicated they would require around $45 per ton, delivered plant gate. Although idled farmland and CRP land is substantial, there seems to be little interest to grow dedicated energy crops such as switchgrass for the biorefinery.

The conversion technology to use different types of wastes and residues and produce both electricity and a liquid fuel, i.e. ethanol, has not been proven on a commercial scale. It has been tested on a small pilot demonstration scale by a few companies who are currently promoting their technology.

There is more evidence of success with projects that produce electricity from biomass and, to a lesser extent, liquid fuel from biomass. There are several commercial scale gasification systems in operation in Japan and Germany but few elsewhere in the world. There is little published information on the profitability of these operations.

Not all gasification systems will be appropriate for the production of fuel, chemicals and electricity. The process must produce the right mixture of hydrogen and carbon monoxide, called syngas. Additional components in the gas would have a negative impact on the cost to produce. Moreover, the syngas must have the correct ratio of hydrogen and carbon monoxide to cost effectively produce fuel and/or electricity for a small scale biorefinery.

There are several catalysts available to convert the syngas into alcohol. However, there are no guarantees on the performance of these catalysts for such a purpose. In order to attract private investment in the Warenton biomass to energy project, one of several federal programs available to demonstrate new technology would have to provide a grant or loan guarantee to cover the risk.

Within a month, PNNL will be recommending a particular gasification system best suited for a small scale biorefinery using MSW and other non-traditional feedstocks. It has completed its evaluation of the technology options and the economic analysis of waste to energy using a gasification system.

The capital costs for a 250 ton/day MSW to ethanol conversion plant based on feedstock properties identified by Antares range from $25 million to $70 million. The low end is

based on a modular, portable plant that is easily assembled on site and will use wastes that have been pre-sorted. The high end is based on a custom designed and engineered plant using a plasma arc conversion process. Plasma arc technology gives the highest yields but has the highest capital cost.

Assuming an alcohol yield of 51 gallons per ton of MSW feedstock and a negative feedstock cost of $13 per ton, the ethanol sales price would have to be $2.91 per gallon to achieve a 10% return on capital investment. If the scale was 400 tons per day, the ethanol sales price would have to be $2.42 per gallon. If higher BTU feedstock, i.e. used tires, wood chips, were used predominately instead of MSW, the ethanol sales price for a 400 ton/day plant would have to be $2.28 per gallon.

The economics of MSW to ethanol improve significantly if the various federal tax incentives are included and 50% of the project cost is funded by a DOE or USDA grant. For a 10% return on investment, the ethanol sales price could then be reduced to $1.07 per gallon.

If the feedstock cost was a negative $40 per ton, instead of a negative $13 per ton, because the county landfill was willing to turn over the entire tipping fee to the plant, the economics would improve even more. Under this best case scenario, the ethanol sales price could be less than $1.00 per gallon.

For MSW to electricity, the economics are not as attractive. To yield a 10% rate of return on a $25 million capital cost, the electricity sales price would have to be 8.8 cents per kwh. If a federal program funded half the capital investment and tax and production incentives for renewable electricity currently being considered by Congress became law, the electricity sales price required would be around 6 cents per kwh.

An economic analysis is being done on the co production of electricity and ethanol .

Both the US Environmental Protection Agency and the Virginia Department of Environmental Quality have reviewed the project and enthusiastically endorse it.

Local government participation is critical to the success of the Warrenton model. Governments own and control the landfill and can assure a long term, consistent supply of feedstock to the plant. They can assist in the negotiation with a utility company for a Power Purchase Agreement. They control the planning and permitting process. They can gather support from the community for such a project. They can provide assistance with state and federal agencies. A public-private partnership is a key to the Warrenton model.