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**COMMENTS ON THE GREENHOUSE GAS IMPLICATIONS OF
SOLID WASTE MANAGEMENT**

As the information in the budget consultation brochures shows, a considerable portion of the average greenhouse gas (GHG) generation per household originates from waste. Maximizing the reduction of solid waste at the household and commercial level is thus well and good, but equally more important for minimizing GHG emissions is what the waste service providers do with the inevitable residual wastes they collect from households and commercial enterprises. The individual waste generator can only indirectly influence the management of the wastes after they are collected through the political process such as participation in this budget consultation. To participate intelligently it is helpful to be aware of the GHG implications of the major waste management options.

I have noted that much of the information provided by the media and available from other public sources is incomplete and that some is inaccurate or even false. To point out what is missing is best done in the context of an overview which includes what European jurisdictions are doing to minimize GHG from municipal wastes, including incentives to encourage effective GHG reduction methods or penalties to hasten the discontinuation of practices which entail high GHG emissions.

An overall inventory of GHG emissions would show that a few percent of the total is attributable to solid waste management, and would further show that most of that portion is caused by the emission into the atmosphere of methane, a potent GHG generated in landfills. So, capturing as much as possible of the landfill gas (LFG), which contains between 50 and 60 percent by volume methane, and burning it for energy generation, or where the flux is insufficient, at least flaring it, is a very effective way of reducing GHG emission and needs to be encouraged or required by regulation.

I have not had time to research Canadian and British Columbia data. An idea of the order of magnitude of the possible effect of best efforts in the solid waste management sector is gleaned from published data for Germany and other European countries. The total GHG reduction in Germany during the period 1990 (Kyoto reference year) to 2005 was about 30 million tonnes of CO₂-equivalent (CO₂-E) which was around 8% of the total reduction in all sectors and over 3% of the total remaining GHG emissions at that time. Over 9/10 of the reduction was due to LFG collection and utilization on existing landfills and the cessation of landfilling untreated putrescible wastes.

Even with good capture, unavoidably a large proportion of the LFG escapes at the open working face or because the completed portion of the landfill lacks a gas-tight cover or because of imperfections in the cover. The Intergovernmental Panel on Climate Change (IPCC), which watches over the Kyoto Protocol, requires assuming as a default value that 50% of the LFG is fugitive. In any case, it is a significant proportion and the reason why the European Commission (EC), in order to meet its Kyoto obligations, has issued a directive which requires the member states of the European Union (EU) to curtail landfilling of untreated and therefore putrescible wastes, in stages, to 35% of the 1990 level by 2016 (with a possible grace period of 4 years for countries which have primarily relied on landfilling, such as the UK). Treatment to eliminate or drastically reduce the gas generation may be effected by thermal reduction or by one or more components of so-called mechanical-biological treatment (MBT). The biological treatment components may be aerobic (composting) or anaerobic (fermentation/digestion) or combinations of these and may have the aim of just stabilizing the waste for landfilling or drying it to facilitate incineration at higher calorific value or, in the case of fermentation, to produce methane for energy recovery. The biological treatment involves mechanical steps but the “mechanical” in the catch-all label MBT probably relates more to the fact that many plants have a purely mechanical pre-treatment component to recover some recyclables (recently with the aid of sophisticated near-infrared [NIR] sorting technology), but primarily to separate a high-calorific fuel for co-firing in conventional solid fuel power plants, or industrial combustors (e.g. cement kilns), or increasingly for incineration in dedicated waste-to-energy (WTE) plants which are of smaller size compared to commensurate conventional plants burning residual wastes. The trend is to build the latter as combined heat and power facilities (co-generation plants) at specific industrial sites using conventional grate or fluidized bed technology. It might be noted that in many European countries garden and food/kitchen wastes (in some countries, for short called biowastes) are collected separately and biologically treated to produce quality compost or biogas, and that therefore the residual wastes contain less organic material than our wastes.

Several European countries have traditionally favored incineration (especially Denmark, and Switzerland) and others have already met the 2016 goal of the landfill directive by recently switching to more incineration (e.g. The Netherlands). In Germany landfilling of untreated wastes had to cease in 2005. Many local jurisdictions opted for the supposedly cheaper MBT so that now about 18 million tonnes per annum (t/a) of residual wastes are incinerated with energy recovery in 72 plants and there is capacity for over 6.5 million t/a in over 50

MBT plants (not counting the numerous composting plants for biowastes). The experience with some of the MBT plants is not satisfactory because of technical problems in some cases, and further the reluctance of power companies and industry to use the refuse derived fuel (RDF) produced by MBT plants. In any case, producers of RDF have to pay on average 75 Euros/tonne (over \$100/t) to have it taken off their hands. It might be mentioned that one of the four big electric power companies just closed two MBT plants it owned and operated because of its inability to fix technical problems, while at the same time two other of the big four power companies are engaged in ownership and operation of perhaps two dozen WTE plants.

Because of low acceptance of RDF and for other reasons, including very high (some say excessively high) environmental standards, the MBT approach cannot even keep its promise of lower costs. It contributes to high costs that landfilling of biologically stabilized residual waste must meet many tough conditions, and even the off-gas from biological treatment has to be cleaned to exacting standards involving regenerative thermal oxidation (RTO) following acid scrubbing and passage through a bio-filter in duplicate air pollution control (APC) systems to assure continuing treatment during an outage of one APC line. Composting plants in Austria are required only to use acid wet scrubbing ahead of bio-filters in order to prevent formation from ammonia of the extremely potent GHG nitrous oxide (N₂O) in the biofilter. MBT interests in Germany agitate for this lower cost treatment to be acceptable there also. After a failed attempt, the EC is still holding off on the promulgation of standards.

This recent experience with MBT in Germany is not fully reflected in the excellent MBT technology assessment by the British consulting firm Juniper Consultancy Services Ltd. although the report (2005) contains many caveats. It remains to be seen whether jurisdictions in the UK which in order to avoid the unloved incineration opt for MBT will repeat the mistakes made in Germany or will be able to avoid them. In any case, punitive taxes for landfilling in the UK are intended to hasten compliance with the EC landfill directive and force local jurisdictions to decide on alternatives to landfilling untreated wastes.

A further directive of the EC with implications for waste management and indirectly GHG is aiming to achieve that a certain percentage of electric power generation (presently 12%) is renewable energy. For this purpose, the said directive recognizes the biogenic and hence

biodegradable fraction of industrial and municipal waste as “biomass” and thus as one of the “renewable energy sources” along with wind, solar, geothermal and hydropower, all of them non-fossil energy sources eligible for one of the listed support programs elected by the member state, possibly including tax exemptions or reductions, tax refunds or direct price support. Research in several European countries reports the biogenic portion of the wastes to be between 60% and 80% counted on the basis of weight or calorific content. It is understood that combustion of that portion does not add carbon dioxide in the long run and therefore it is not counted in reporting GHG, or rather is allowed in claiming GHG avoidance.

Aside from knowing the proportions of biodegradable and fossil content, conversion of all the waste to energy can be viewed as avoiding the extraction of virgin fossil fuel from the ground, because most electric power systems have a fossil-fuelled component, or must consider adding one to keep up with demand or else have to import some fossil-fuel generated power. To get an idea of the magnitude of the possible substitution I calculated that 500,000 tonnes of residual waste can replace about 300,000 tonnes of brown coal or be a substitute for 40 million m³ of natural gas when all three fuels are used for electric power generation with efficiency typical for each. These figures result from a simple direct comparison without regard to the effect of externalities, which in any case would not drastically change them. In practice, WTE power is a substitute only for baseload power generated with virgin solid fossil fuel (coal), while oil or gas are reserved for covering peak loads or compensate for lows in the output of wind or solar power generators. As a generator of baseload power, WTE generally is more valuable to power companies than weather-dependent wind or solar power for which quick response standby has to be available.

I hope to have clarified some GHG implications of solid waste management and perhaps corrected some mistaken notions, and thereby to help decision makers in considering support measures which are effective in the quest for climate protection by reducing the emission of GHG, if not in the coming budget perhaps in future ones. Apart from any fiscal incentives, regulatory intervention may be necessary if the waste management sector is to do its appropriate share in achieving the ambitious goal of overall 33% GHG reduction, set by the government, which will place BC in the forefront of climate protection efforts in Canada.