Life Cycle Assessment of Two Waste Management Scenarios for Metro Vancouver

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Study Overview

Use Life Cycle Assessment (LCA) to evaluate the life cycle environmental burdens of two solid waste management scenarios: Landfilling and Waste-to-Energy (WTE)

- Identify major material and energy inputs & outputs
- Quantify these inputs and outputs at a planning level of accuracy
- Create an equivalent basis for comparison of scenarios

Study Scope

Parameters that were evaluated:

- Fuel consumption
- Energy inputs and outputs
- Greenhouse gas (GHG) emissions
- NOx, SOx, Particulate Matter (PM_{10}), Mercury, Dioxins & Furans

All inputs and outputs expressed per *functional unit* defined as **one tonne of solid waste disposed**

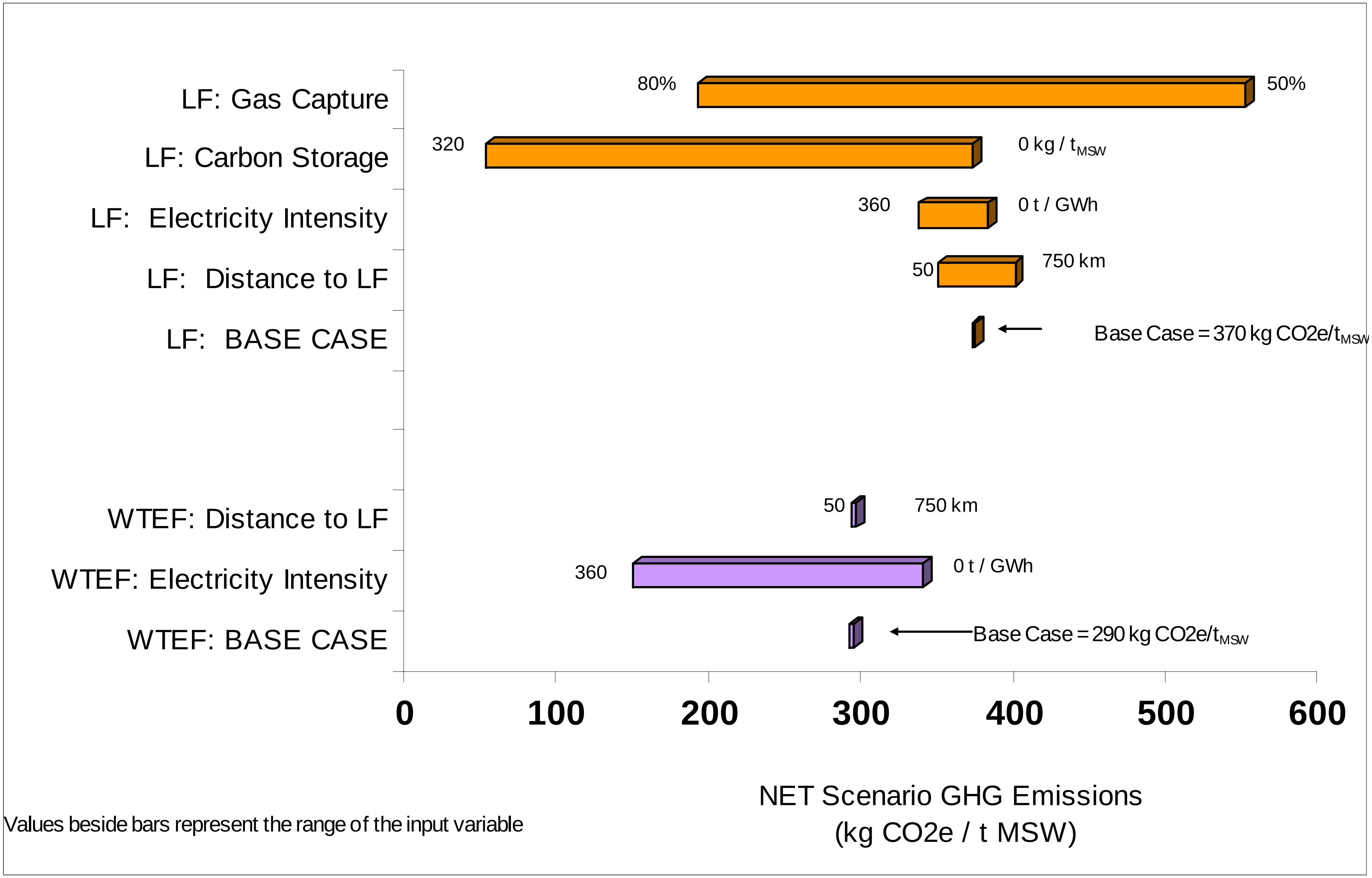
Study Assumptions

- Annual Operating Capacity = 750,000 tonnes/year
- Total Disposal Capacity = 50 million tonnes
- Landfill located within 750 km of the region
- Waste-to-energy facility located within 25 km of region
- Transport loads/mileage as per current activities
  - Landfill – 40 tonne capacity trailers
  - WTEF – 27 tonne capacity transport trucks
- Vehicle emissions consistent with upcoming low emissions diesel regulations

Summary of Results

Item (Note: All results are for the **Base Case** evaluation)	**Units**	**Landfill Scenario**	**WTE Scenario**
Resource Consumption / Production			
Net Electricity Production Rate *NB Landfill values are lifetime average and (range)*	MW (a)	7.2 (0 to 12)	45
Net Electricity Production (LCA basis)	kWh / / t_{MSW} (a)	125	527
Heat Production Rate *NB Landfill values are lifetime average and (range)*	MW (a, b)	8.9 (0 to 15)	28
Heat Production (LCA basis)	GJ / t_{MSW} (a, b)	0.56	1.18
Fuel Consumption	L / t_{MSW}	8.6	3.1
GHG Emissions			
Greenhouse gas emissions (CO2 equiv)	kg CO2 equivalent / t_{MSW}	369	291
Air Contaminants			
NOx	kg NOx / t_{MSW}	0.47	0.19
SOx	kg SOx / t_{MSW}	0.06	0.08
PM_{10}	kg PM_{10} / t_{MSW}	0.13	0.03
CO	kg CO / t_{MSW}	6.10	0.09
Selected Contaminants			
Mercury emissions (total mass)·	mg Hg / t_{MSW}	0.35	32
Dioxins / Furan emissions (total mass)	µg 2,3,7,8 TCDD / t_{MSW}	0.019	0.032

Sensitivity Analysis



Conclusions

- Transportation emissions relatively minor
- WTE recovers almost five times more electricity and heat than Landfilling
- GHG emissions are 370 kg CO_2e/t_{MSW} for Landfilling and 290 kg CO_2e/t_{MSW} for WTE
- Landfilling produces higher emissions of NOx, PM_{10}, and CO (due to cogeneration and flaring of landfill gas); SOx emissions are similar in two scenarios

Conclusions (cont.)

- Difficult analysis given complex issues such as energy offsets and carbon sequestration
- LCA can be viewed as environmental component of a Triple Bottom Line analysis
- Trade offs exist between scenarios
- Need an integrated system approach based on 5Rs:
  - Zero Waste Challenge
  - Material and Energy Recovery (e.g. composting & WTE)
  - Residuals Management