Application of a LCA Models in Guiding the Development of Solid Waste Management

Recycling Council of British Columbia

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Golder Associates

Outline

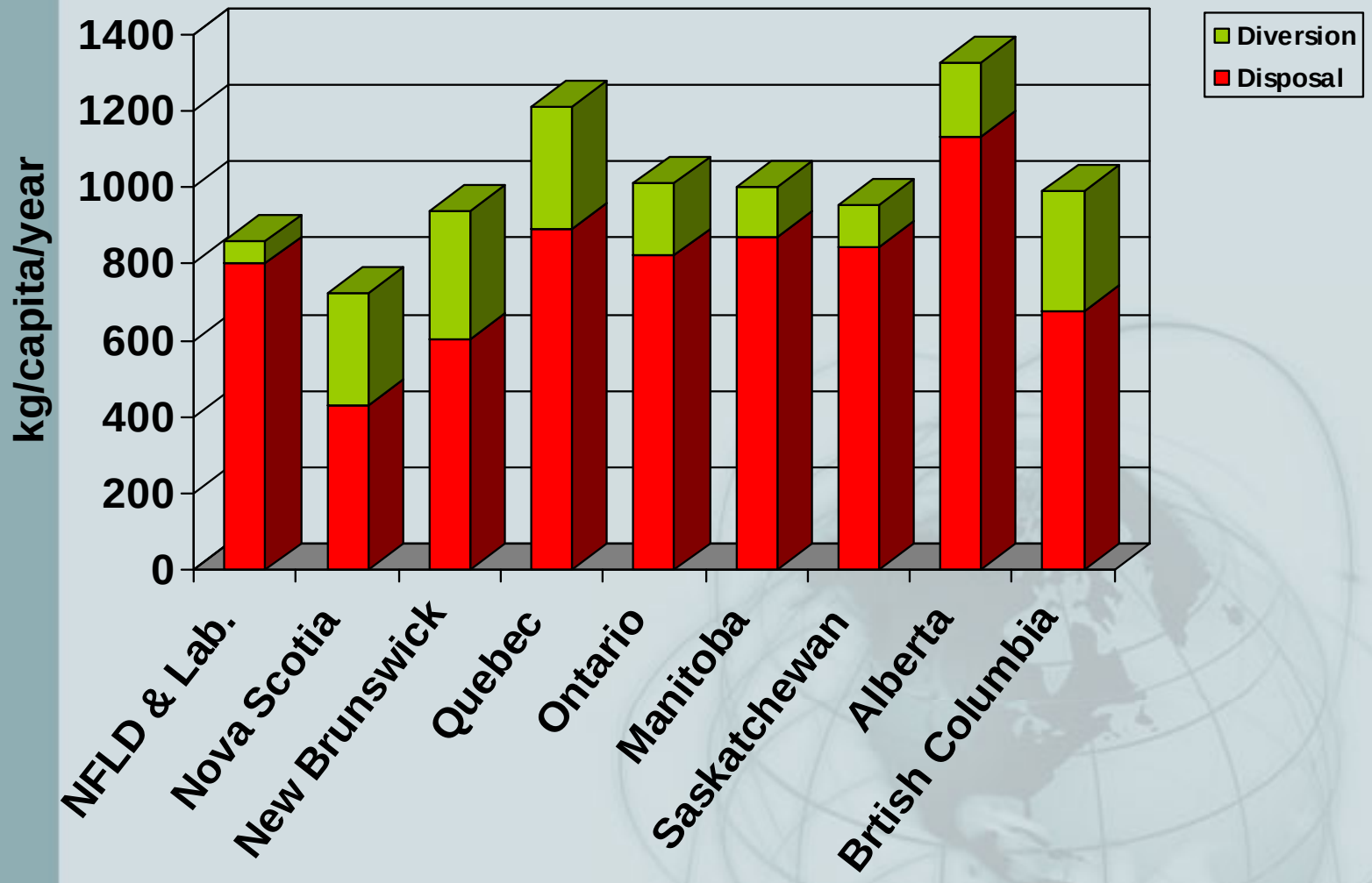
- Waste generation in Canada and GHGs
- Evolution of LCA concept
- Life Cycle Assessment
  - Introduction to the LCA stages
- LCA software characteristics
- WRATE Model
  - Data and modelling
  - Results
- Notes of caution
- Final remarks

Trends in MSW in Canada

Year	Total Disposal	Total Diversion	Total Generation	Diversion Rate
	kg/capita	kg/capita	kg/capita	
1996	697	182	879	21%
1998	688	222	926	24%
2000	753	199	952	21%
2002	769	212	980	22%
2004	773	222	995	22%
2006	835	237	1,072	22%

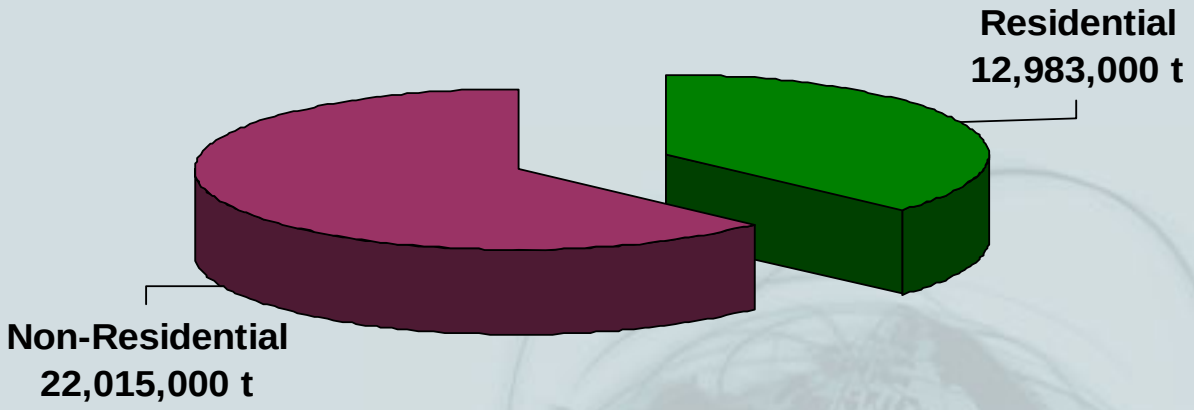
Source: Statistics Canada 1999 - 2008

2006 Provincial Generation Disposal and Diversion



Data from the territories and PEI are not provided due to confidentiality reasons
Source: Statistics Canada 2008

- Households contribute to approximately 37% to overall MSW generation
- Residential Waste Diversion = 29%
- Non-Residential Waste Diversion = 18%



Source: Statistics Canada 2008

Trends in MSW in Canada

Residential MSW Generation (1996 – 2006)

Year	Total Disposal	Total Diversion	Total Generation	Diversion Rate
	kg/capita	kg/capita	kg/capita	
1998	233	77	316	25%
2000	295	70	365	19%
2002	302	89	391	23%
2004	275	105	379	27%
2006	283	115	398	29%

Source: Statistics Canada 1999 - 2008

GHG Facts : Waste

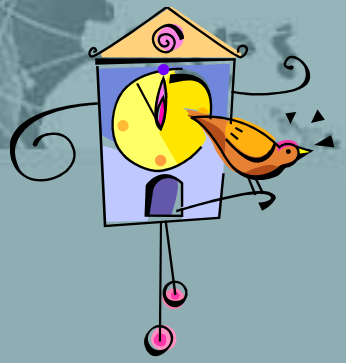
- National Inventory for Waste includes:

1. Solid Waste Disposal on Land
2. Wastewater Handling
3. Waste Incineration

GHG Facts

- Solid Waste Disposal on Land
  - 1990 22 MT CO_2e (3.7% of National total)
  - 2005 28 MT CO_2e (3.3% of National total)
- BC 4.2 MT CO_2e (8.3%) in 1990 from landfills
- BC 4.9 MT CO_2e (7.4%) in 2005 from landfills

Evolution of LCA



First computerized waste planning models

Approaches compare alternative disposal strategies from a $ point

Multi Criteria analysis

Analysis of recycling schemes

Scenario Modeling, economics of material recycling

Different Life Cycle Assessment applications and tools in different countries

WRATE

European Union LCIA methodologies and inventories

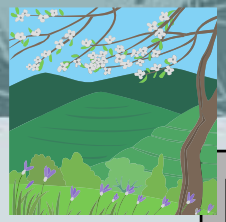
1960s 1970s 1980s 1990s 2000s 2008s

Specific Aspects: Routing of collection vehicles, location of Facilities: focus was $

More holistic approach that included environmental considerations but under only $ concern

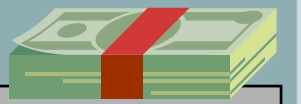
LIFE CYCLE MANAGEMENT to assist decision making, LCA, LCC, CBA

Holistic View



Environmental

Social



Economic

IWM and Sustainability

Technological

Local Characteristics

Life Cycle Assessment (LCA)

Systematic process that quantifies and compiles inputs






And outputs



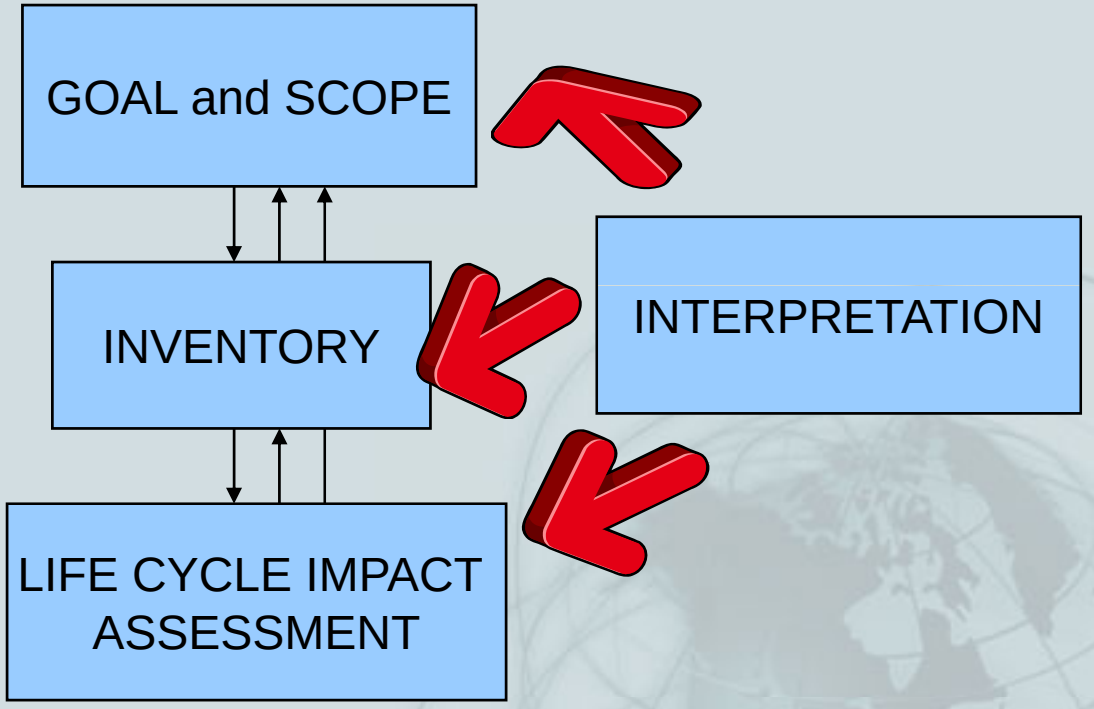


of a system, defining the potential environmental impacts.

LCA is the a means to assess the environmental impacts of a product, system or activity over its entire life cycle: “Cradle to Grave”

LCA in Waste Management

- The process looks at all processes from the moment waste has been generated and consists of 4 stages (ISO, 1997, 2006)



- Identifies opportunities to improve the environmental performance of the system at various points in the *LIFE CYCLE* including the effects on the surrounding systems (e.g., energy systems)

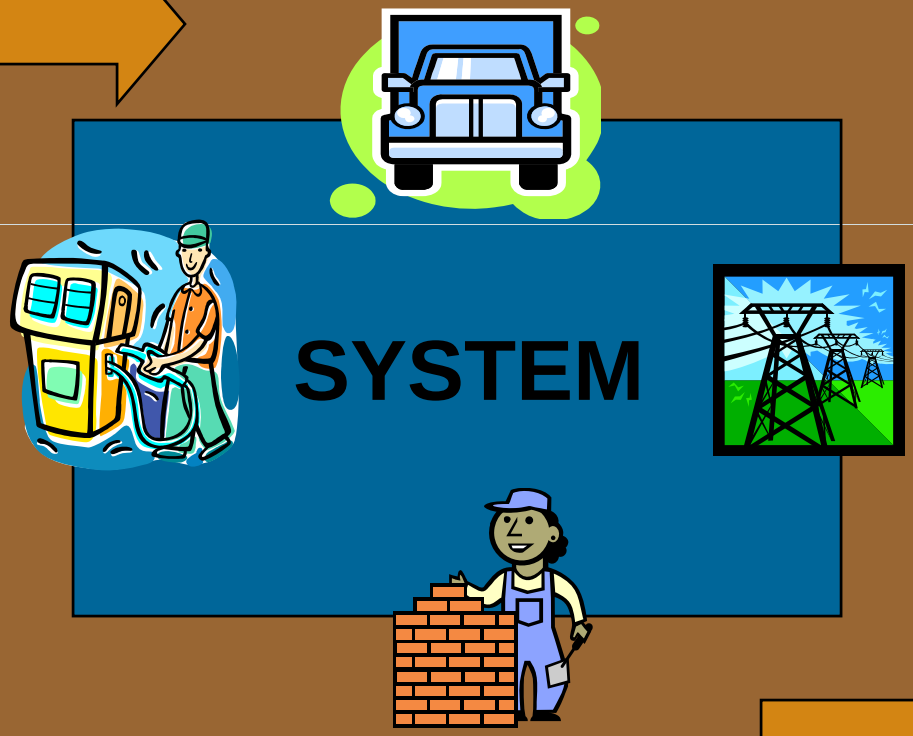
Inventory Analysis

INPUTS

Materials Consumption
Concrete
Fuel
Paint
Oil
Water…

Energy Consumption
Fuel
Coal…

Waste Inputs
Household Waste
Litter…



OUTPUTS

Air Emissions
CO2
SOx
Dioxins…

Water Emissions
Mercury
Lead…

Soil Emissions
Aluminum
Arsenic…

Resource Depletion
Coal
Molybdenum

LCA Tool Key Characteristics

- Support to evaluate complex processes
- Help to structure the modelled scenario
- Present results in a simple and user friendly fashion
- Contain the background data necessary to undertake meaningful and defendable LCA

Interest in LCA Tools Varies By Stakeholder Group

Industry

Wish to improve the performance in process optimisation and product development

Require ready to use software

Scientists & Researchers

Have in-depth knowledge and understanding of LCA

Model complex processes

Require high quality data

More than one impact assessment methodology used

Decision Makers

Interested in user friendly tools easy to understand and use

Require a simple presentation of results to enable the dialogue between stakeholders

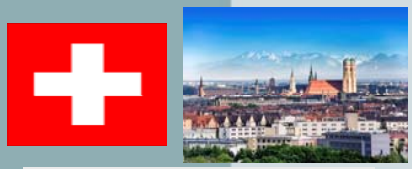
Require a defendable process to support decision making

Common LCA Tools Applied to WM

ORWARE

US IWM
Traci

Sima Pro



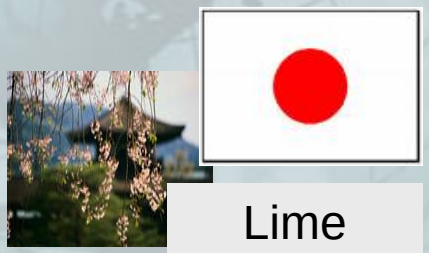
IMPACT 2002
Eco Indicator 99

Lucas
IWM

Gemis
Gabi
Humberto

IWM
WISARD
WRATE

EDIP 2003



Lime

WRATE

Waste
Resource
Assessment
Tool
Environment

Probably contains the most comprehensive inventory of waste management processes comprised in related process stages: construction, maintenance, decommissioning, fuels, energy, materials, water and emissions

Potential Users

Municipal Authorities

Central Government

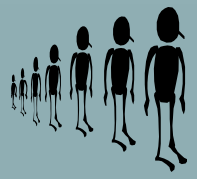
Technology Providers

NGO

Regulators

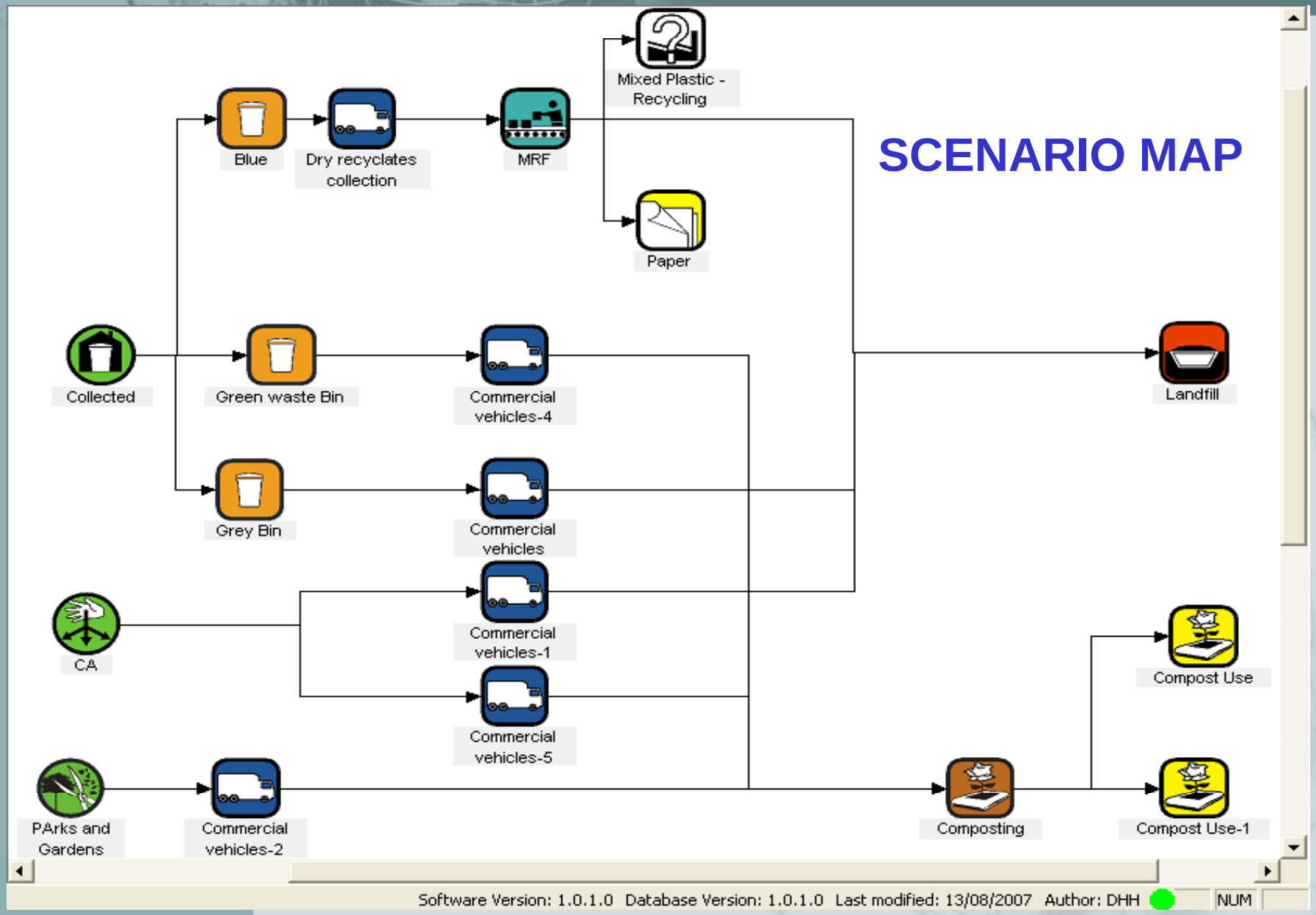
Private Industry

What Type Of Data Do You Need To Feed It?



- Waste tonnage, population, number of households
- Waste streams
  - Household
  - Bulky household
  - Commercial
  - Green waste
  - Construction and demolition
  - Street sweeping
- Waste composition (paper, plastic, organics, metals, glass, etc.)
- Electricity mix
- One (or preferably more) scenarios to test information on current waste management
- Type of collection vehicles used and other transport involved in managing waste streams
- Transport distances to different facilities
- Details of existing and/or proposed facility/plant capacities

Waste Management Stages for the Scenarios



Typical Details Needed: Collection Vehicle Process

RCV - garden waste

Transport Properties | Inputs | External Management

Transport Name: 6x4 RCV - ULS Diesel (12278)

Kerbside vehicle - caged LCV (12067)
Kerbside vehicle - compartment RCV (12027)
Kerbside vehicle - split body RCV (12103)
LGV Fleet (12040)
LGV Petrol Fleet (12045)

Synonym

User Entered Name

Year of the data

Life Span [km]: 200000

Max capacity (Mass) [tonnes]: 12.842

Max capacity (Volume) [l]: 24500

Mass (Empty) [tonnes]: 13.158

Mass (Full) [tonnes]: 26

Fuel Type: on-road gasoil (ULS diesel)

Cumulative Distance Data: ☑

Distance A to B [km/trip]: 0

Cumulative distance [km/year]: 1000

Urban (%): 33.33

Rural (%): 33.33

Motorway (%): 33.34

100.00

Process Description: 6x4 Refuse Collection Vehicle and body. ULS Diesel air emissions

Comments

It contains a finite number of processes but others can be added as User Defined Processes

OK | Cancel | Apply | Advanced | Restrictions | Help

LIFE CYCLE IMPACT ASSESSMENT

OUTPUTS

CO

Pb

Hg

Dioxins

CO_2

etc.

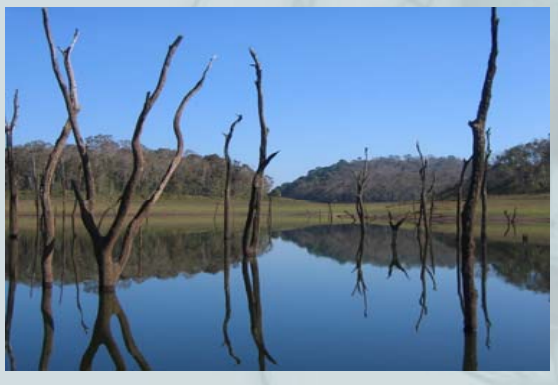
Global Warming Potential

Acidification

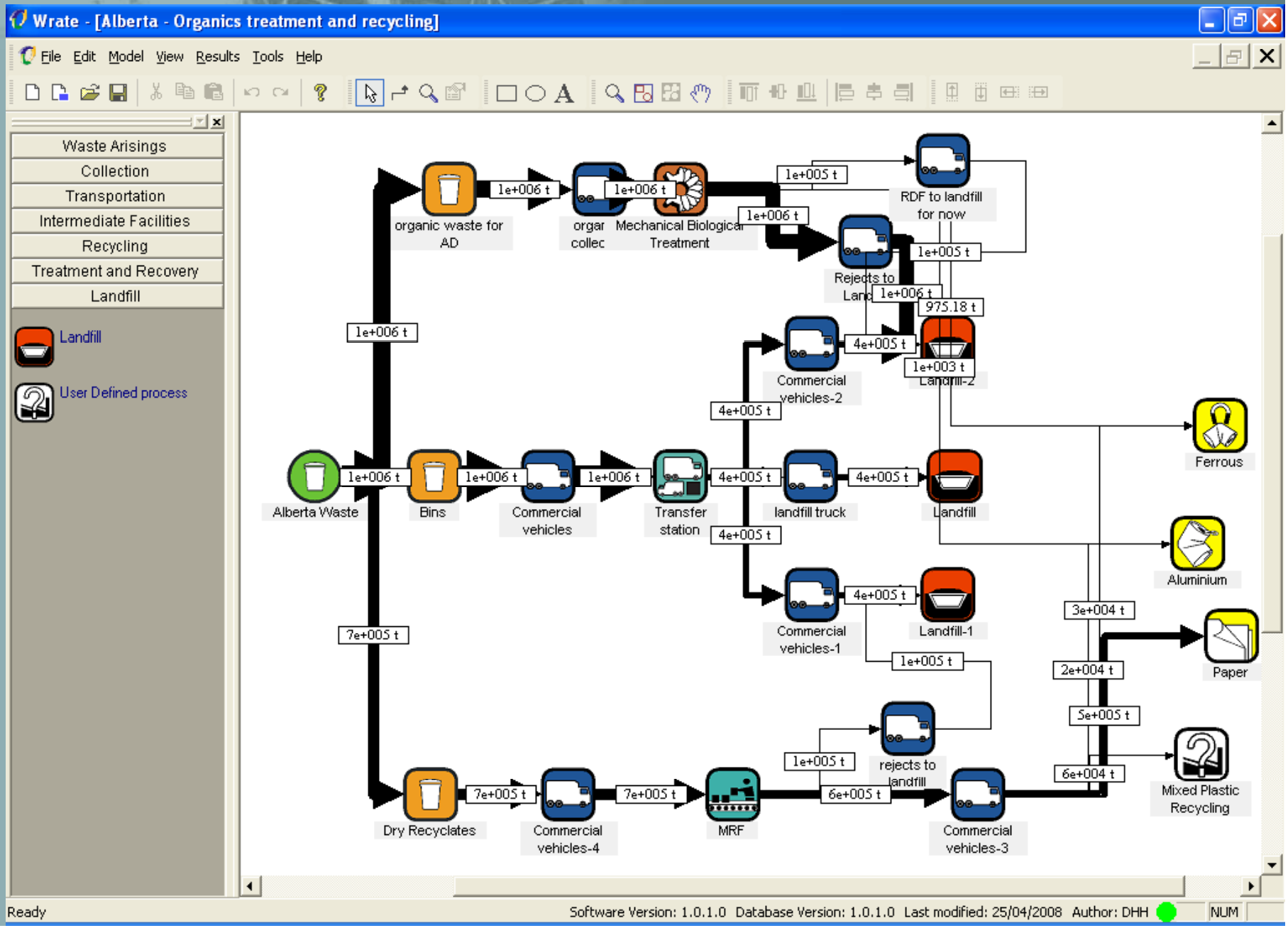
“Assigning life cycle inventory results to environmental impact categories”

“Stakeholder process to identify/rank importance of impact categories”

Eutrophication

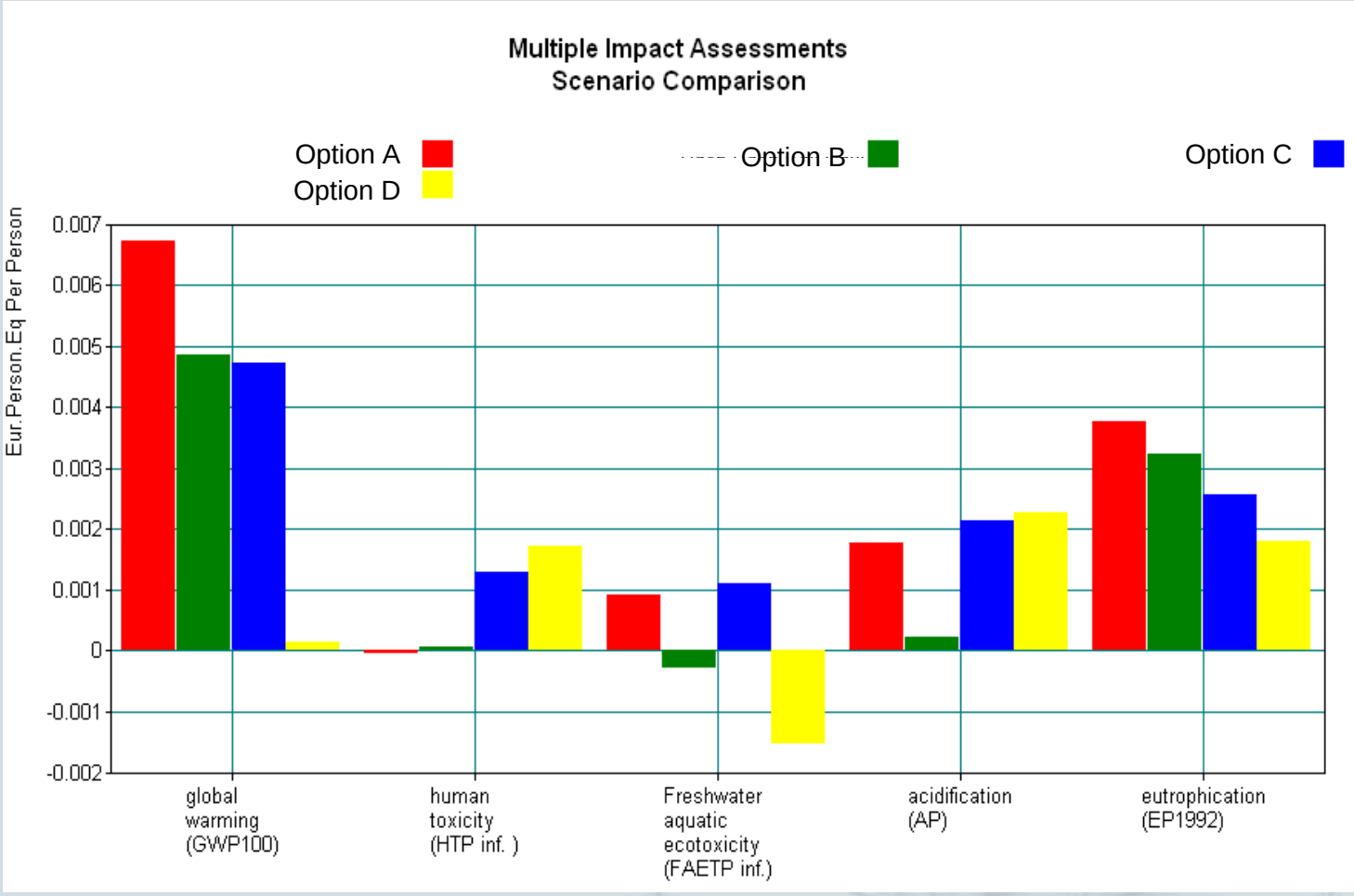


Alberta? (2016?) some Organics treatment and MBT



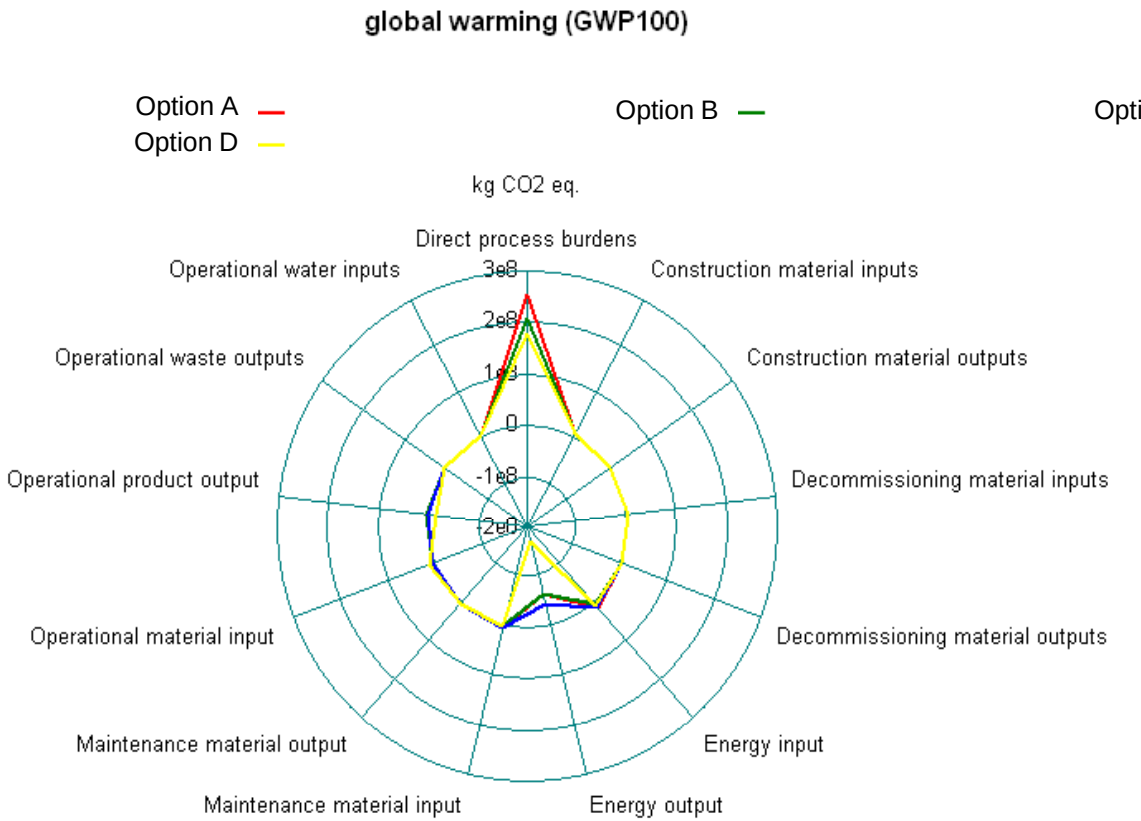
RESULTS: What You Get For Your Efforts

Ability to compare two or more scenarios and develop a management scenario with the smallest environmental footprint



RESULTS: Comprehensive

Provides a comprehensive (“holistic”) overview of the system and avoids simply shifting the source of the pollution from one life cycle stage to another



And what you get for your efforts

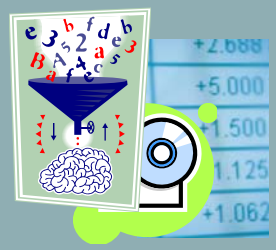
- What you really get is the ability to compare two or more scenarios and develop a scheme with the smallest environmental foot print.
- It allows comparison of different technologies
- It’s Defensible – but it will not make the decisions for you as it does not deal with the financial and social side.

Some notes of caution

- The impacts have no time scale.
  - They are integrated over all time.
- The impacts do not relate to a specific geographic area.
  - Something that uses less electricity will benefit the environment but not necessarily local to your site, or even in this country!

Final Remarks

- LCA is a defendable decision making tool. It communicates complex information in an easy to understand format

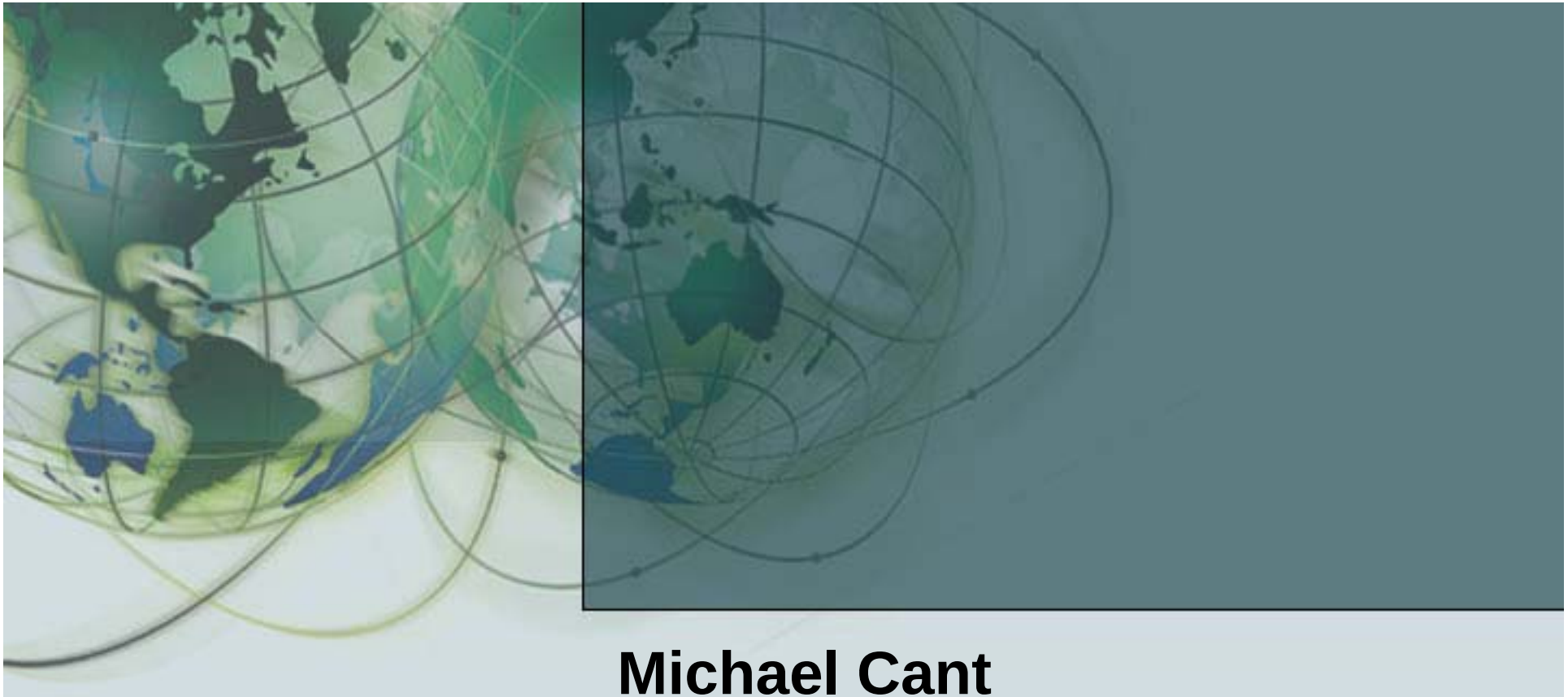


- WRATE follows ISO standard LCA principles providing a defendable and standardized tool for policy makers and environmental managers

- WRATE is the most recent Waste-LCA developed but may need some modification and translation for use in other countries

- WRATE already contains Life Cycle Inventory for many waste management processes, from the manufacturing and raw material burdens of plastic carts and film disposal bags to those of an incinerator

- LCA output can support a complimentary assessment of social and financial aspects to support “triple bottom line” decision making



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