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Management of Municipal Solid Waste in Metro Vancouver –

A Comparative Analysis of Options for Managing Waste After Recycling

Summary of Study Results

June 12, 2009

Overview

1) Context and Description of Technologies
2) Life Cycle Assessment
3) Air Emissions Comparisons
4) Financial Analysis

Metro Vancouver: a Zero Waste Region

- Zero Waste Challenge
  - Goal 1: Minimize waste generation
  - Goal 2: Maximize reuse, recycling and material & energy recovery

  - Diversion to increase from current level of 55%
  - Programs identified to reach 70% diversion by 2015

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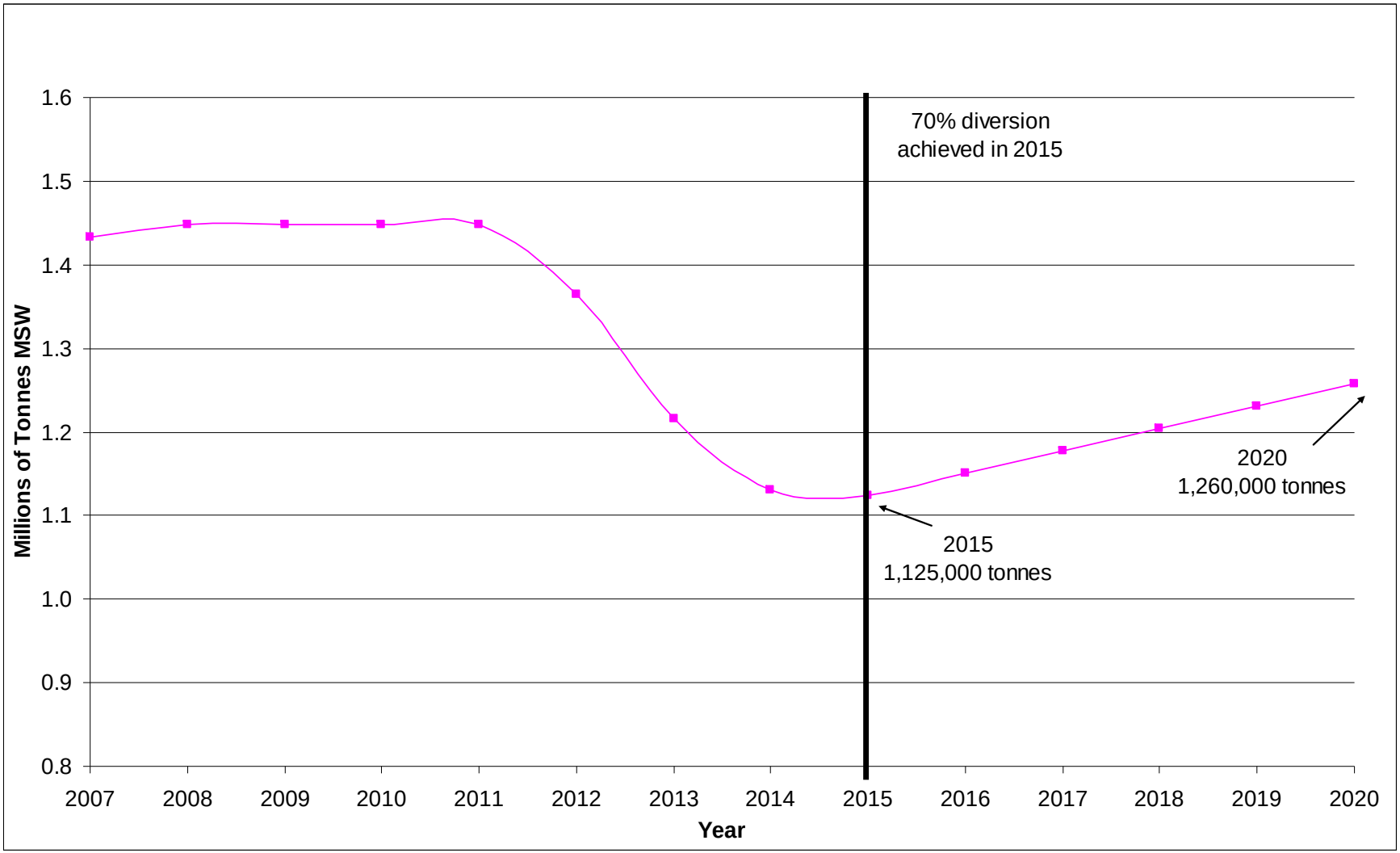
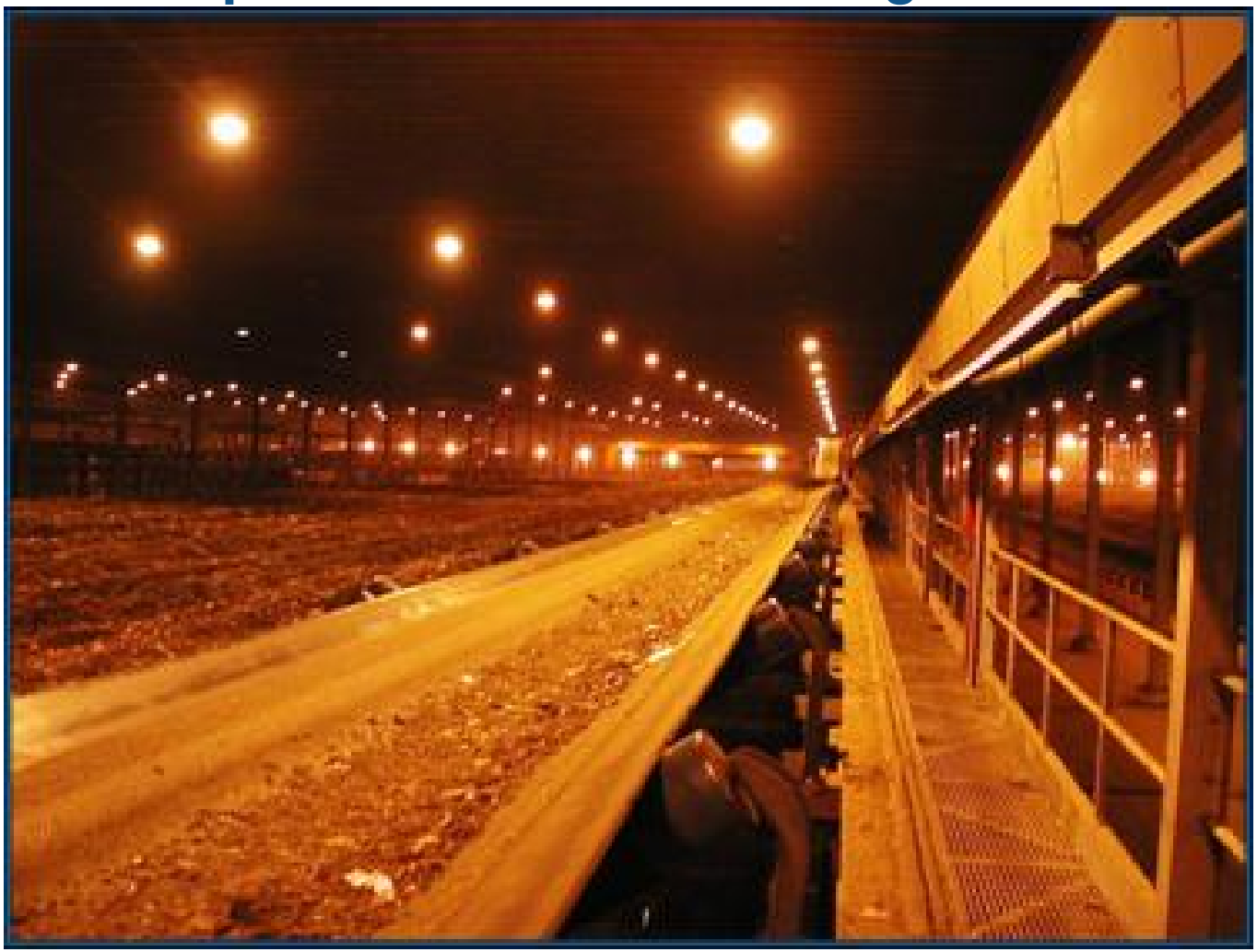
Waste Requiring Further Treatment and Disposal



Technologies for Materials & Energy Recovery from MSW

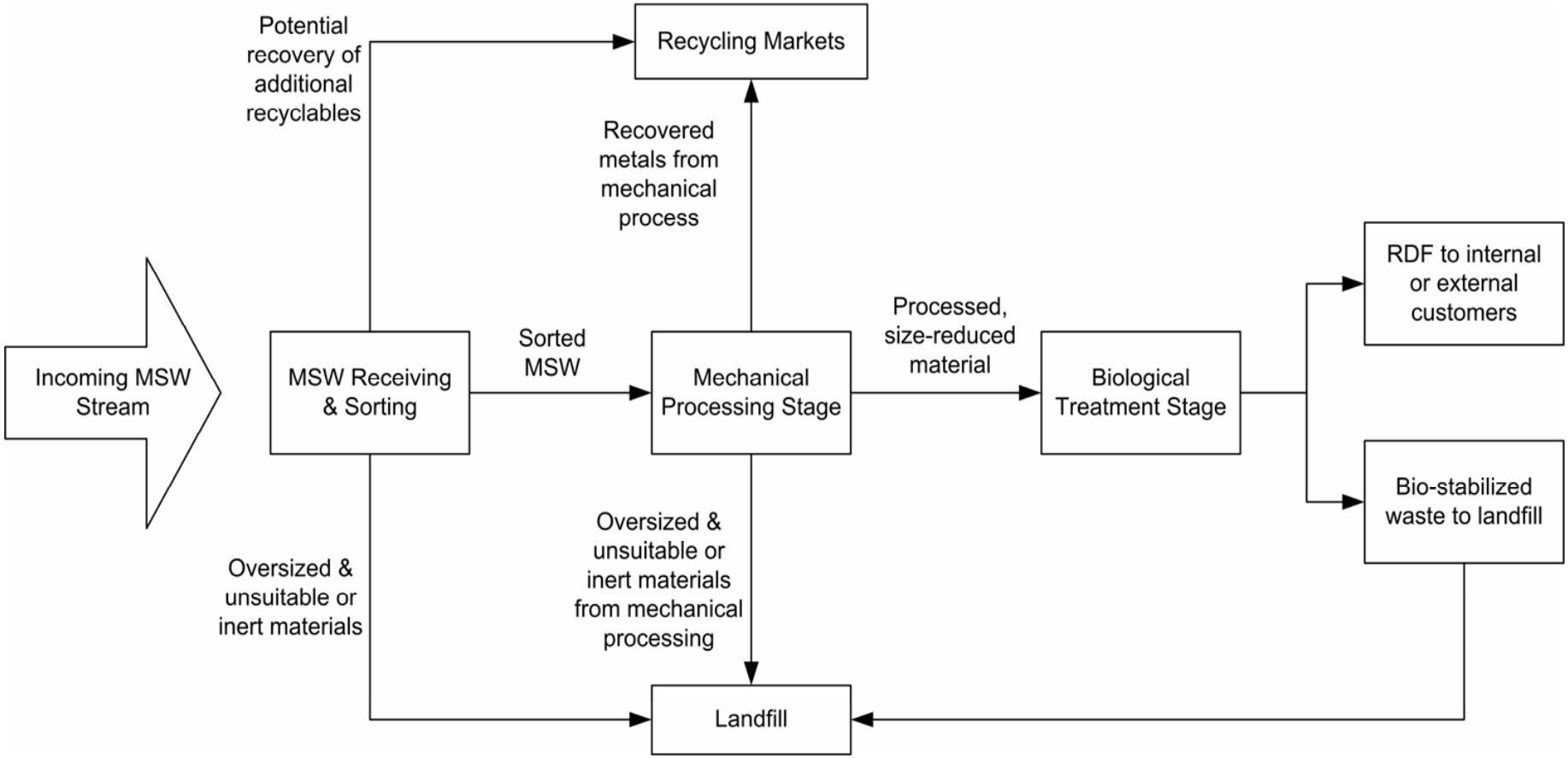
- Mechanical Biological Treatment (MBT)
- Waste to Energy (WTE)
- Landfill, with landfill gas recovery and utilization

Treatment Option: Mechanical Biological Treatment



MBT Facility in Edmonton

MBT Process


Potential recovery of additional recyclables
Recycling Markets
Recovered metals from mechanical process
Incoming MSW Stream
MSW Receiving & Sorting
Sorted MSW
Mechanical Processing Stage
Processed, size-reduced material
Biological Treatment Stage
RDF to internal or external customers
Bio-stabilized waste to landfill
Oversized & unsuitable or inert materials
Oversized & unsuitable or inert materials from mechanical processing
Landfill

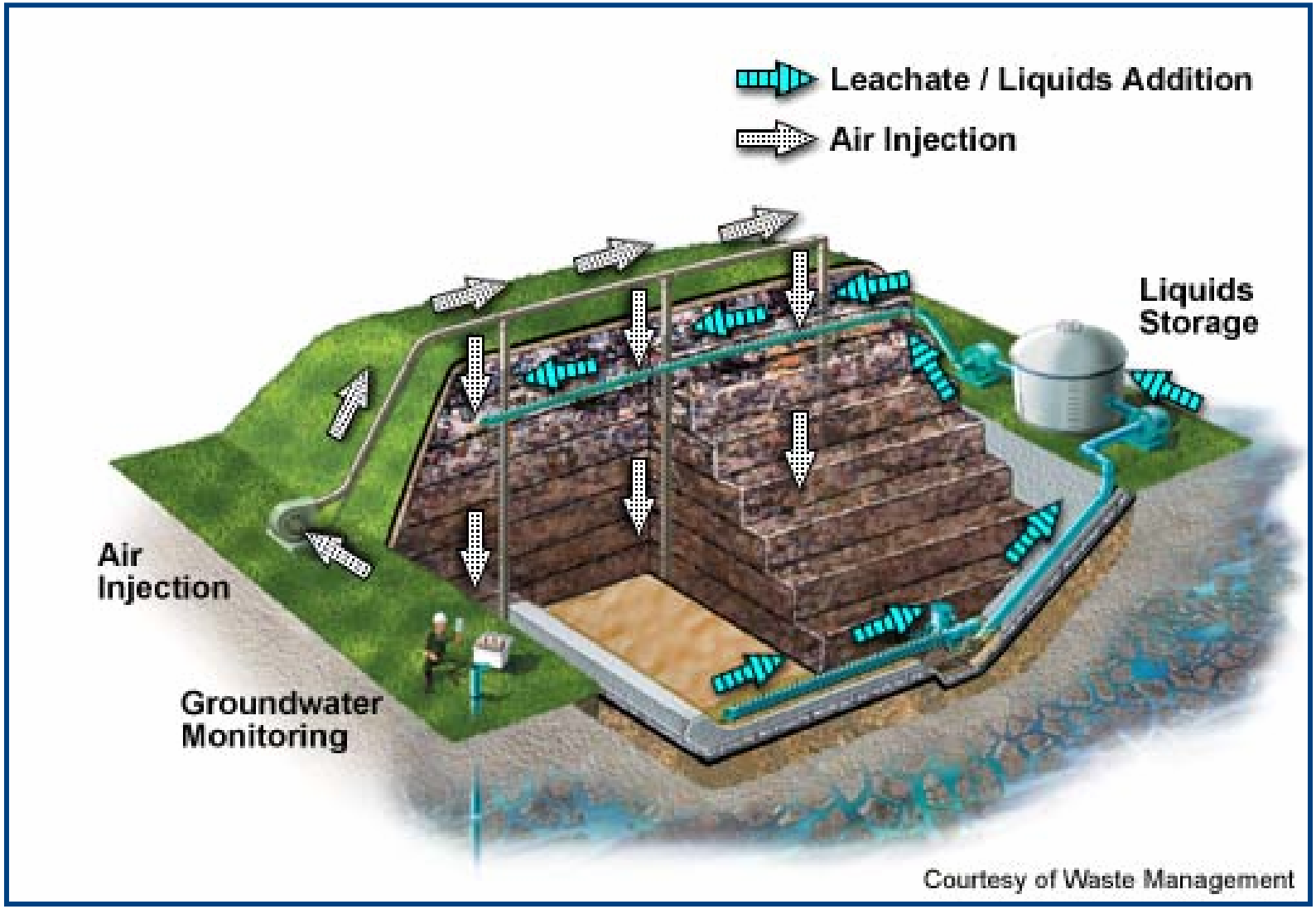
Treatment Option: Waste to Energy

WTE Facility in Paris, 500,000 tonnes per year

Waste to Energy Details

- Mass burn technology used in analysis
  - Ultimate technology will be decided through competitive process
  - Mass burn is a proven system with over 800 plants worldwide
- Over 90% thermal efficiency with district energy systems
  - Replaces natural gas use
- Generates local, firm electricity
  - 20% to 27% electrical efficiency
- Net GHG emissions can be comparable with landfill
- Reduced trucking compared to long-haul options

Disposal Option: Modern Landfill with Gas Recovery



Landfill Details

- Oldest waste management technology, extensively used in North America
- New landfills are fully lined with leachate collection (may include leachate recirculation)
- Landfill gas (LFG) recovery and utilization
- LFG capture modeled at 75% for new and existing landfills
- 10% of remaining LFG oxidized by cover, balance of LFG escapes to atmosphere

Application of these technologies to Metro Vancouver's MSW

- 8 scenarios involving various combinations of WTE, MBT and landfill
- Life Cycle Assessment (LCA)
  - Energy balance
  - Emissions balance
- Financial analysis
  - Levelized system costs
  - Accounting costs
  - Cash flows
- All scenarios include continued use of Vancouver Landfill and Metro Vancouver WTE Facility

Scenarios

(Existing WTE Facility + scenario + balance of untreated MSW landfilled)

	Name	Description
1	Large new WTE	750,000 t/a new WTE capacity
2	Moderate new WTE	500,000 t/a new WTE capacity
3	In region use of RDF product	500,000 t/a to MBT facility for RDF
4	Out of region use of RDF product	500,000 t/a to MBT facility for RDF
5	Waste exported out of region to WTE	500,000 t/a exported to out of region WTE facility
6	Local landfilling of MBT product	995,000 t/a processed by MBT and locally landfilled
7	Maximize local landfilling	750,000 t/a to Vancouver Landfill, remainder to out of region LF
8	Maximize out of region landfilling	230,000 t/a to Vancouver Landfill, majority to out of region LF

Eight Scenarios for Evaluation and Comparison

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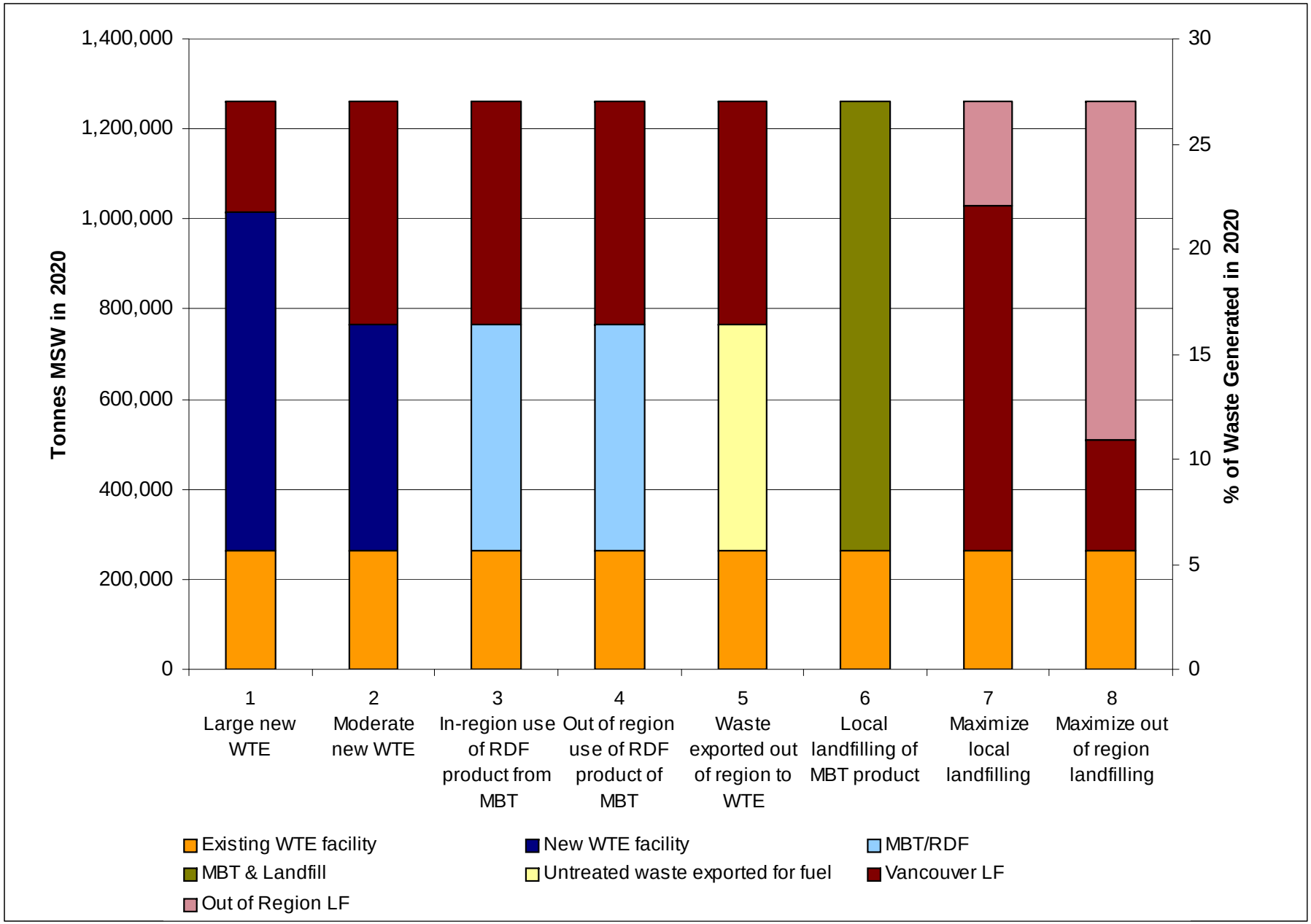
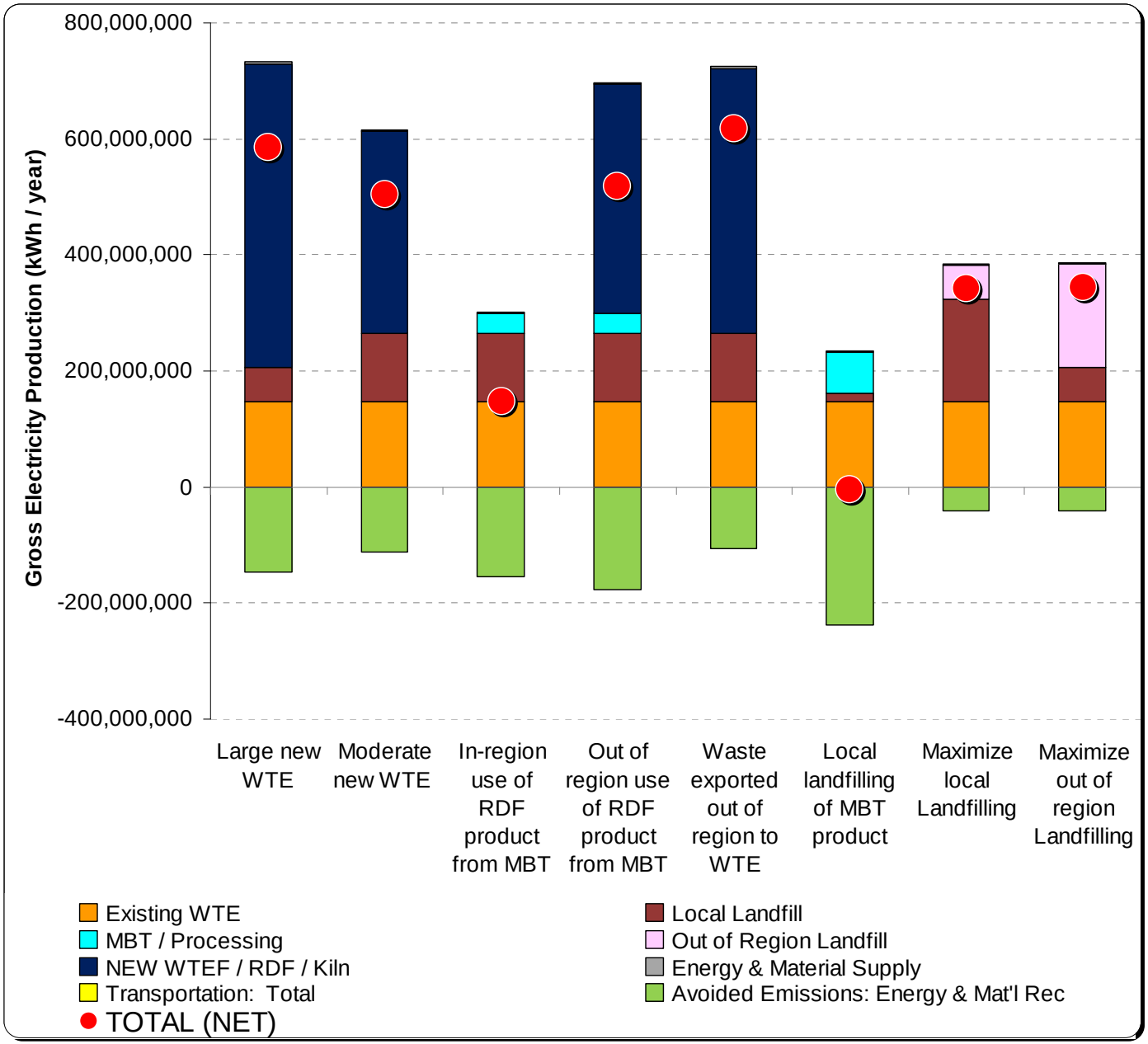
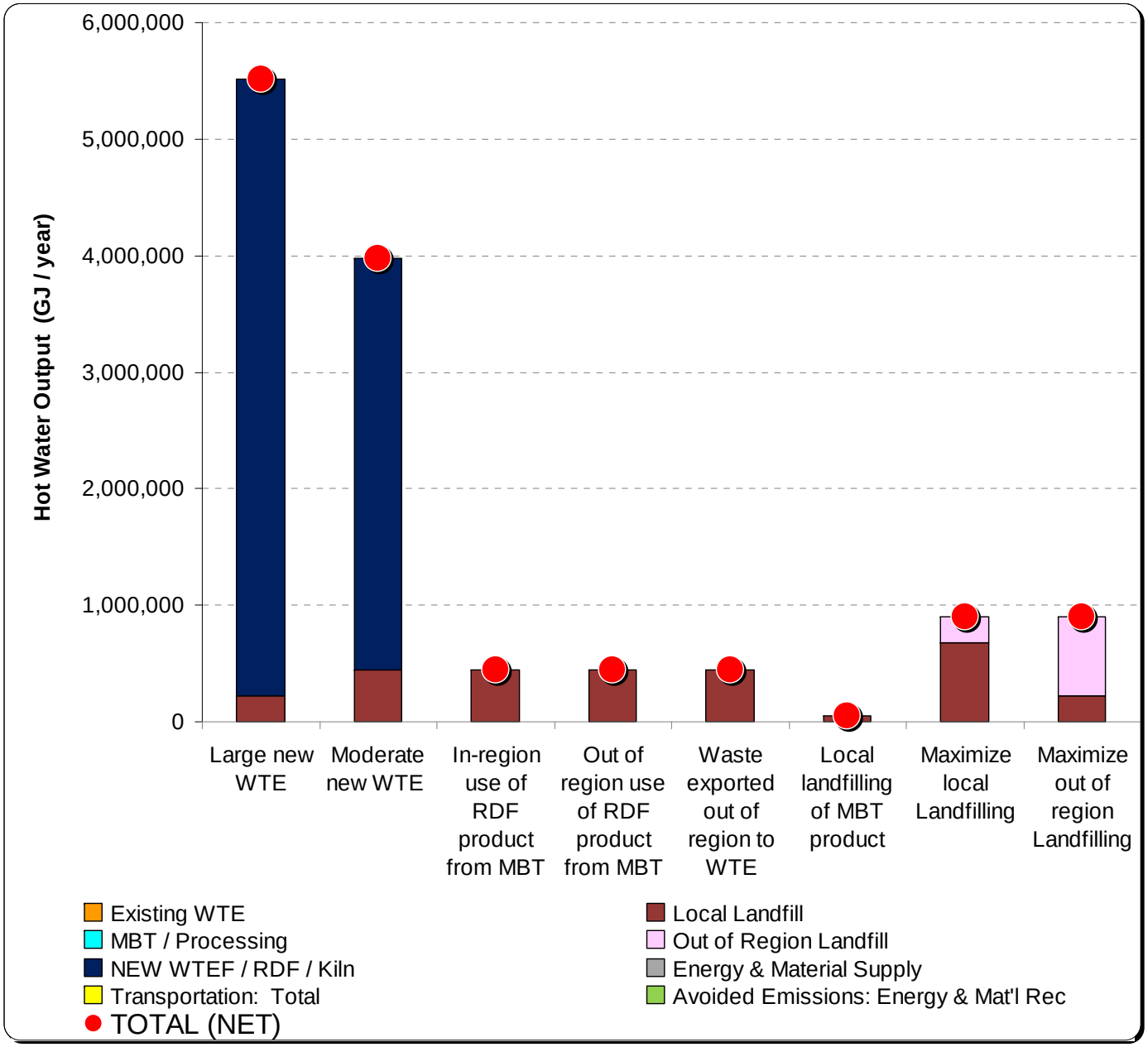


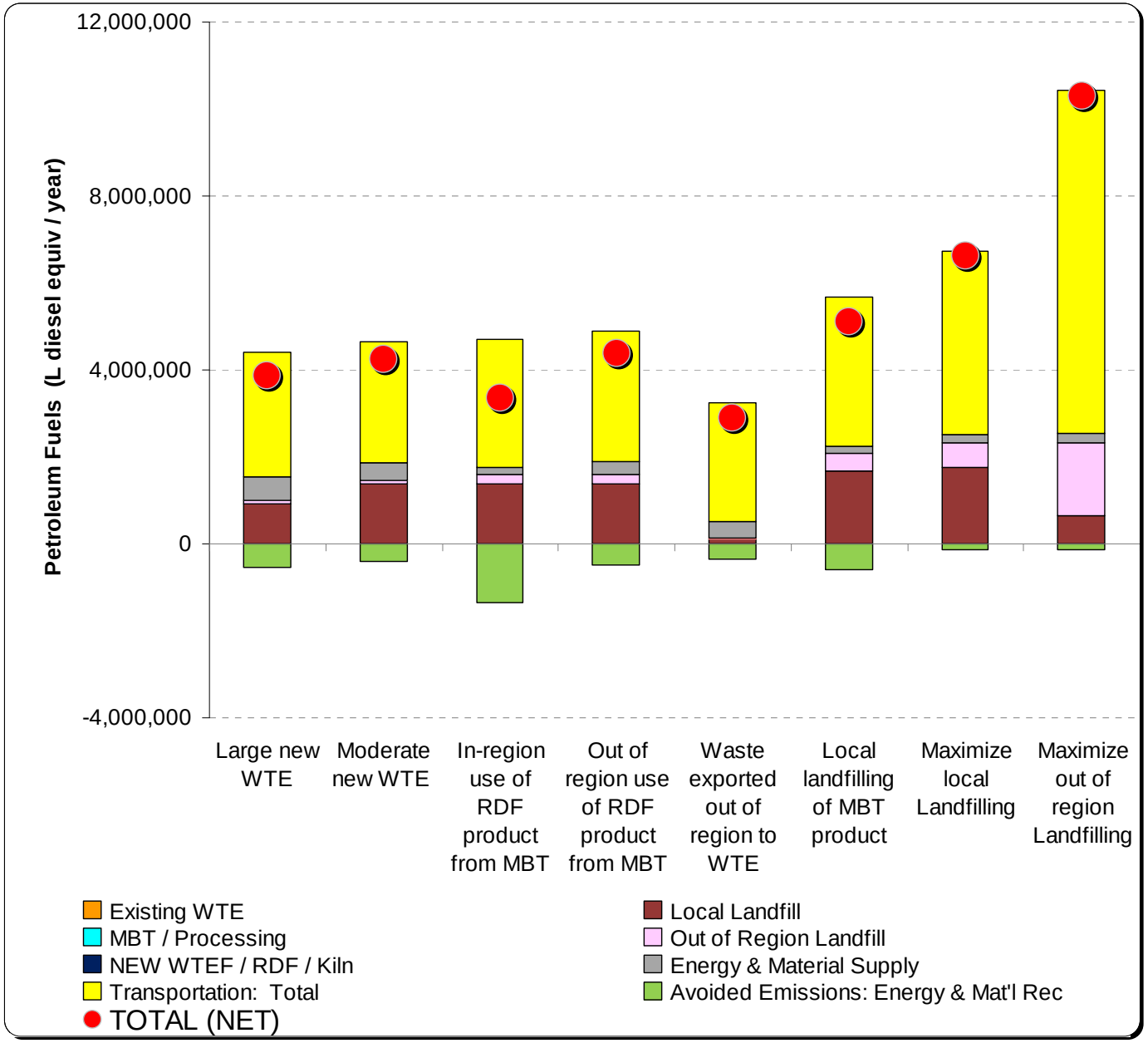
Net Electricity Consumption & Production



Hot Water Generation for District Energy



Petroleum Fuel Balance



GHG Balance

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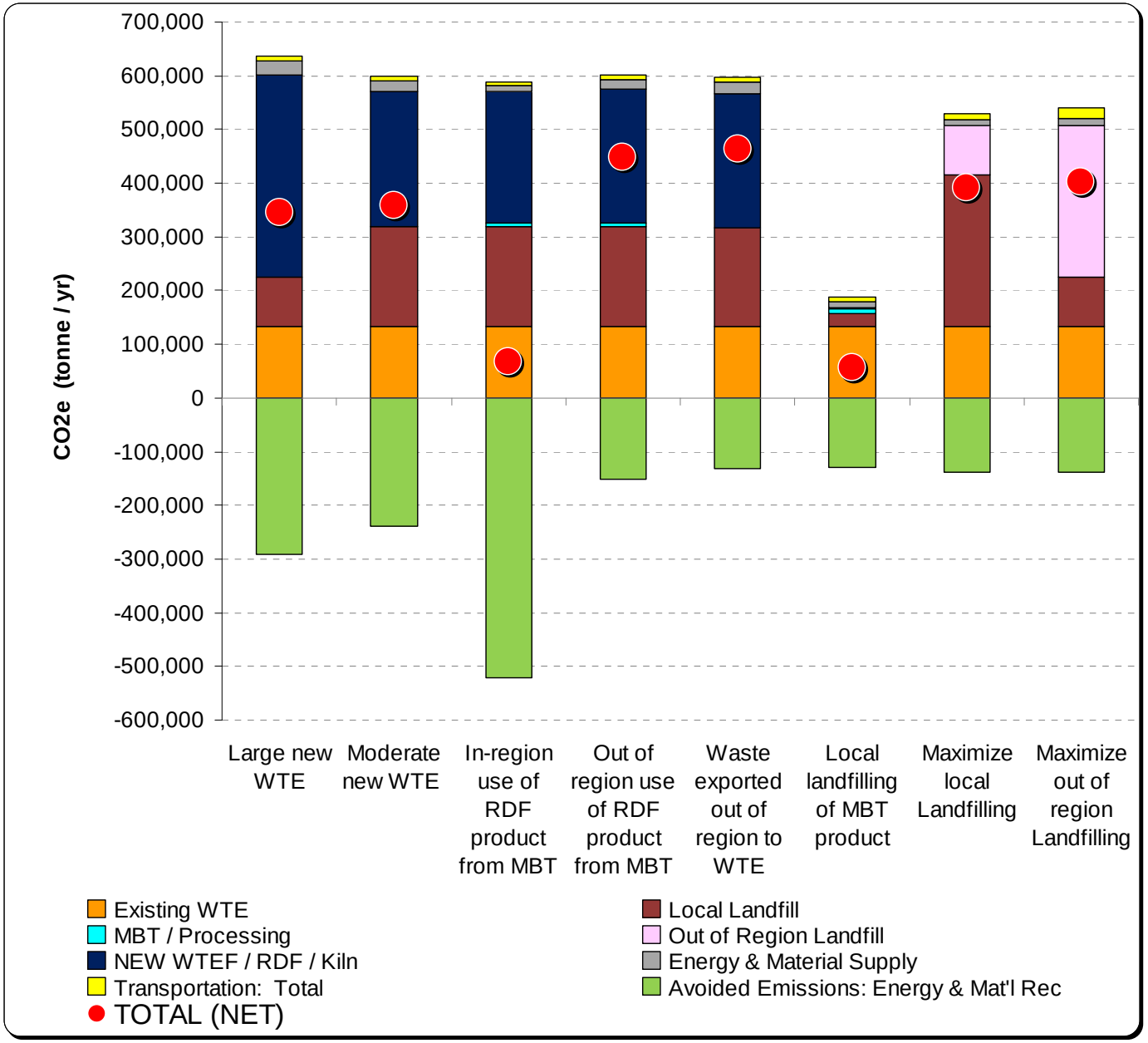


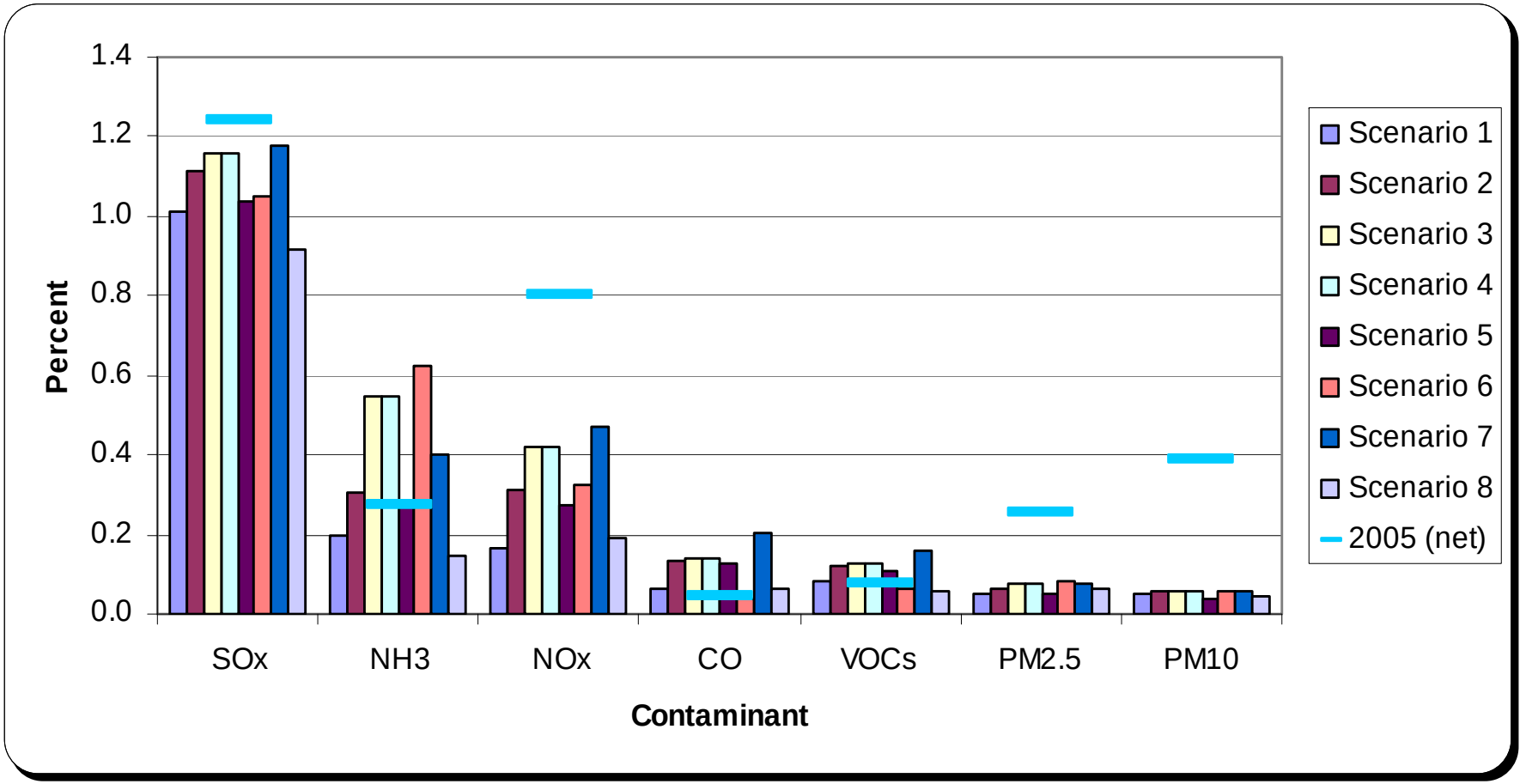
Key Lessons from Life Cycle Analysis

- Transportation is not a key source of air emissions, including GHG (but does consume energy)
- Low carbon electricity in BC means that electricity generation results in limited avoided GHG emissions
- Displacing natural gas through district heating use avoids GHG and air emissions
- Local emissions can be different from total lifecycle results

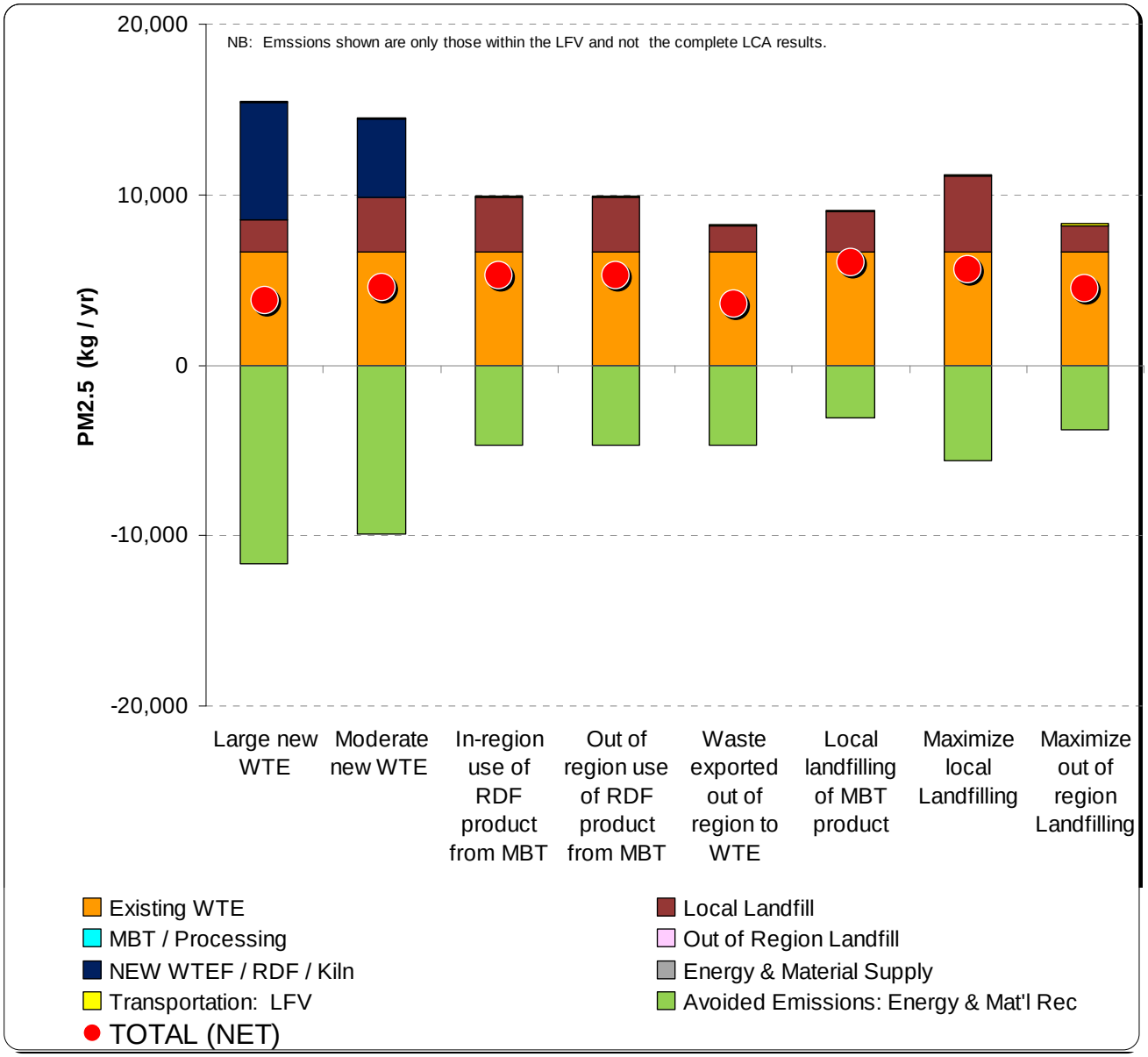
Comparison of Results to Lower Fraser Valley (LFV) Airshed

- Compares net LCA emissions in LFV to Metro Vancouver's forecasted emissions in 2020 for Common Air Contaminants (CAC) and BC estimates for GHG
- 2020 CAC emissions forecast was based on the following MSW-related assumptions:
  - Existing WTE facility upgraded with Select Catalytic Reduction to reduce NO_x
  - Remaining waste sent to either the Vancouver Landfill or an out-of-region landfill
- Additional air dispersion modeling has been completed

2020 Projected Air Emissions in LFV from MSW Scenarios



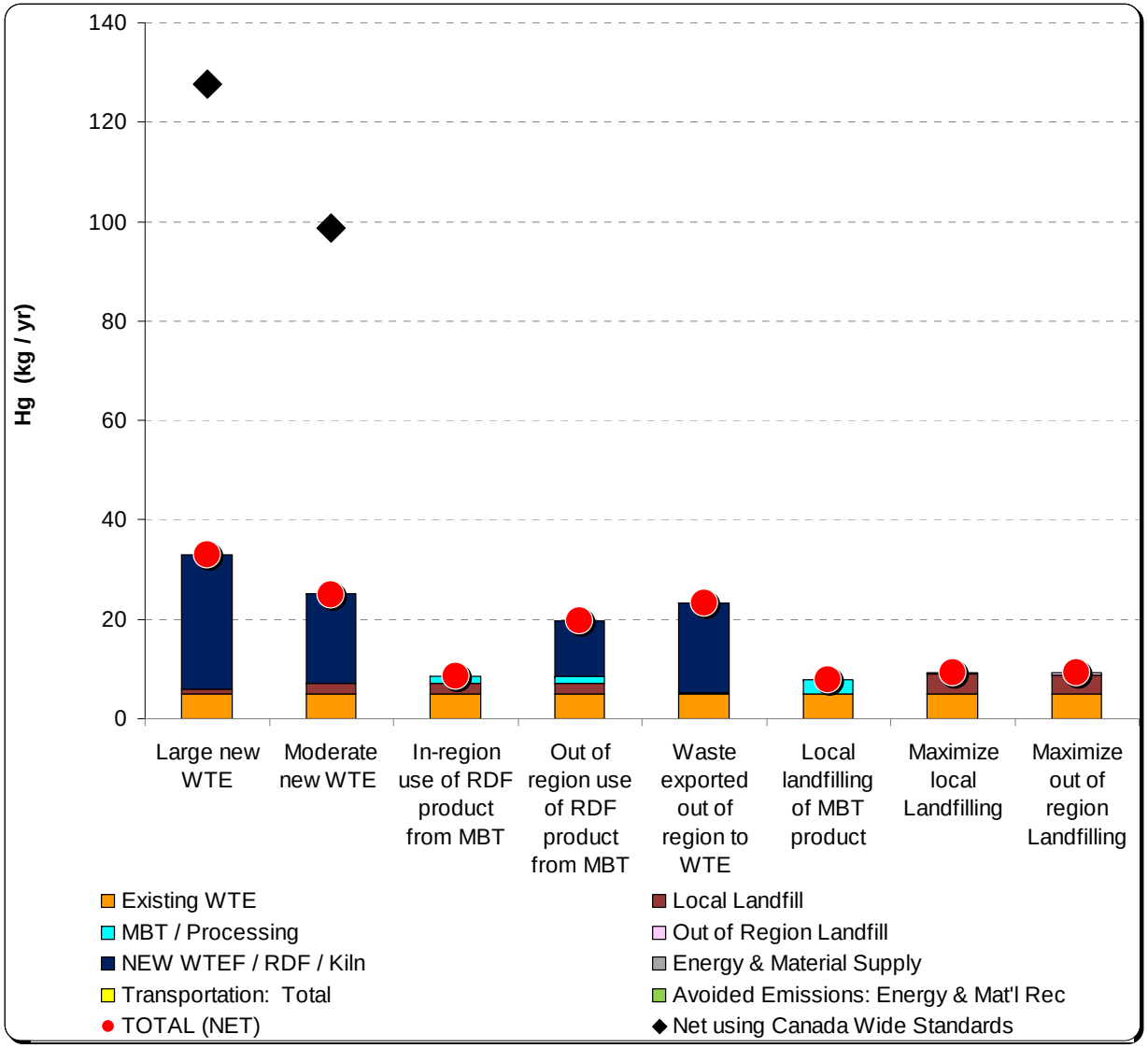
Fine Particulates PM 2.5 in Lower Fraser Valley



Observations on Lower Fraser Valley Airshed Loading

- Generally, all scenarios have similar loadings on airshed
- NO_x and particulate emissions of special interest because they are precursors to smog
  - For base case scenarios:
    - WTE with district heating would have lowest net NO_x emissions
    - In-region landfilling would have highest net NO_x emissions
  - If WTE for electricity production only, (no district heat):
    - WTE in the Region would have higher NO_x emissions than landfill
  - Out of region landfills still have NO_x emissions, but they don't affect LFV airshed

Mercury Emissions Total



Dioxin and Furan Total Emissions

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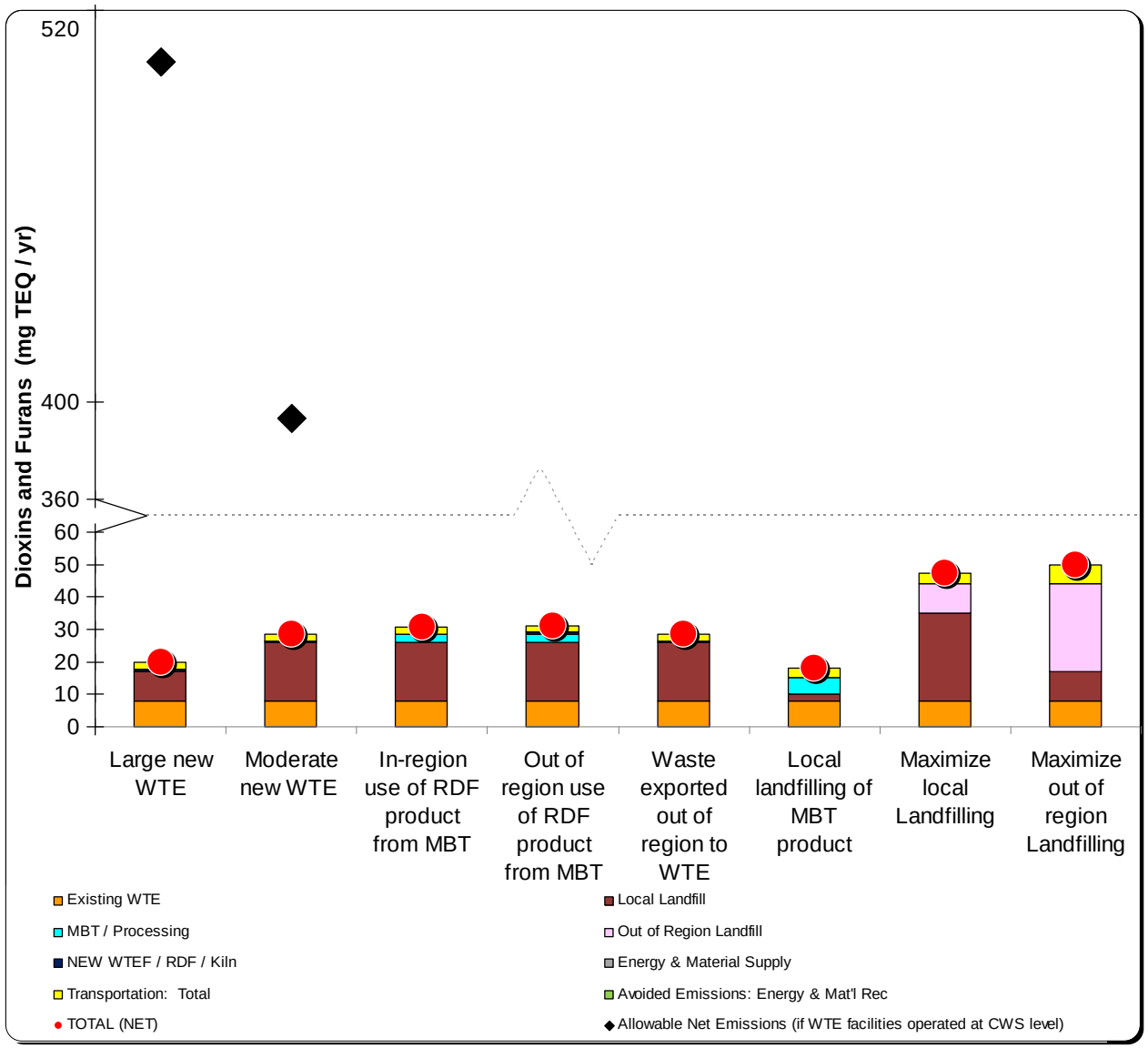

Mercury and Dioxins and Furans observations

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- Mercury
  - Mercury emissions from waste management scenarios contribute less than 3% to LFV airshed
    - WTE scenarios emit more mercury than landfilling scenarios
  - Estimated emissions only 25% of what Canada Wide Standards would allow
  - Mercury emissions will decline substantially when the Province's new product stewardship programs focusing on removing mercury containing products are implemented
- Dioxins and Furans
  - Loading on LFV airshed from all scenarios around 1%
    - Landfill scenarios emit more dioxins and furans than WTE scenarios
  - Less than 10% of what Canada Wide Standards would allow

Financial Model

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- High level model designed to show comparative costs
- 35 year timeframe (to 2045 inclusive)
- Calculates levelized costs & accounting costs
- Costs are as realistic as possible, but for treatment and disposal only (i.e. no collection or transfer station costs)
- Sensitivities examined for:
  - Decreased revenue from electricity
  - Reduced sales of district energy
  - Sale of electricity only

Levelized System Costs

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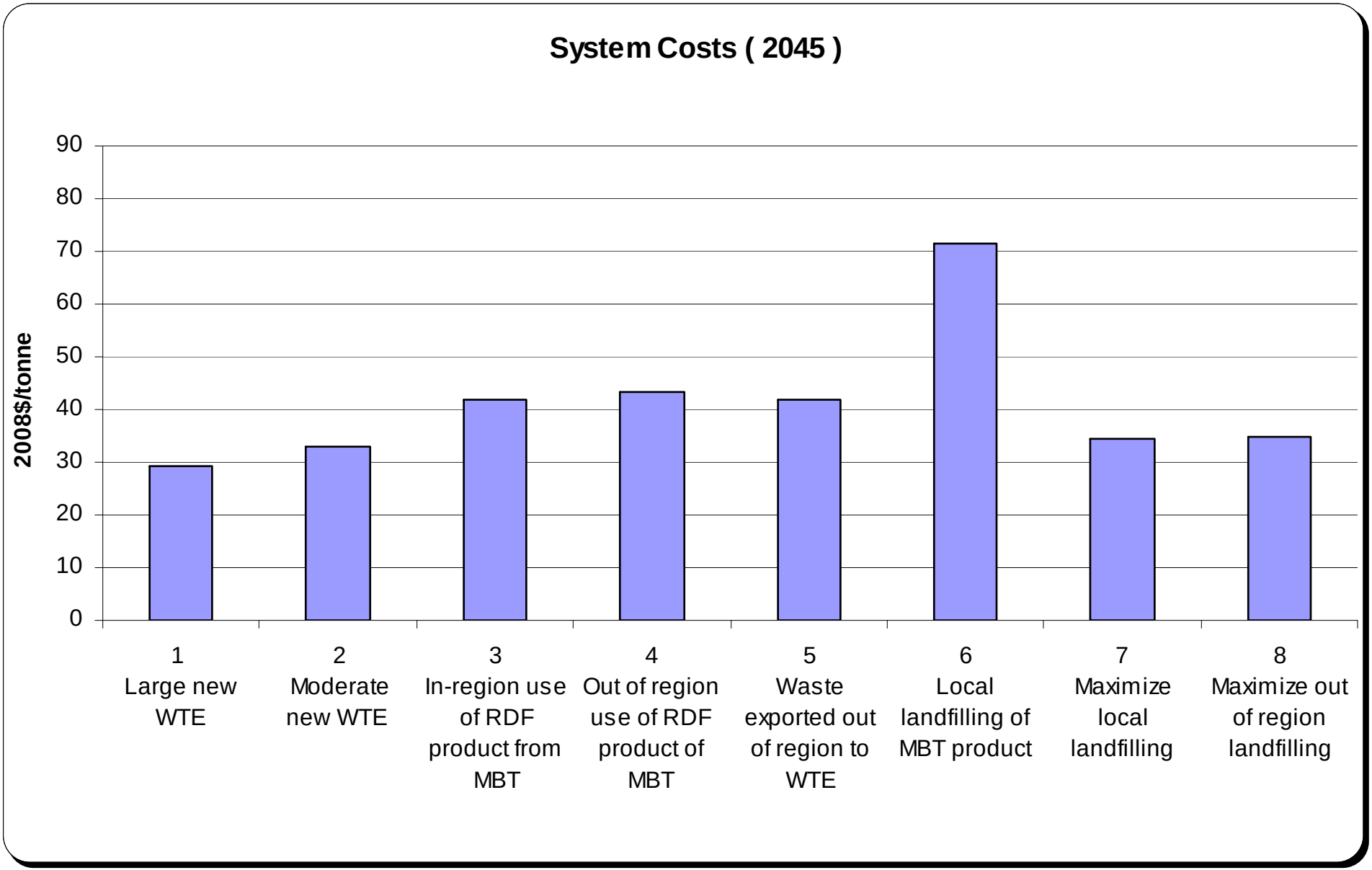


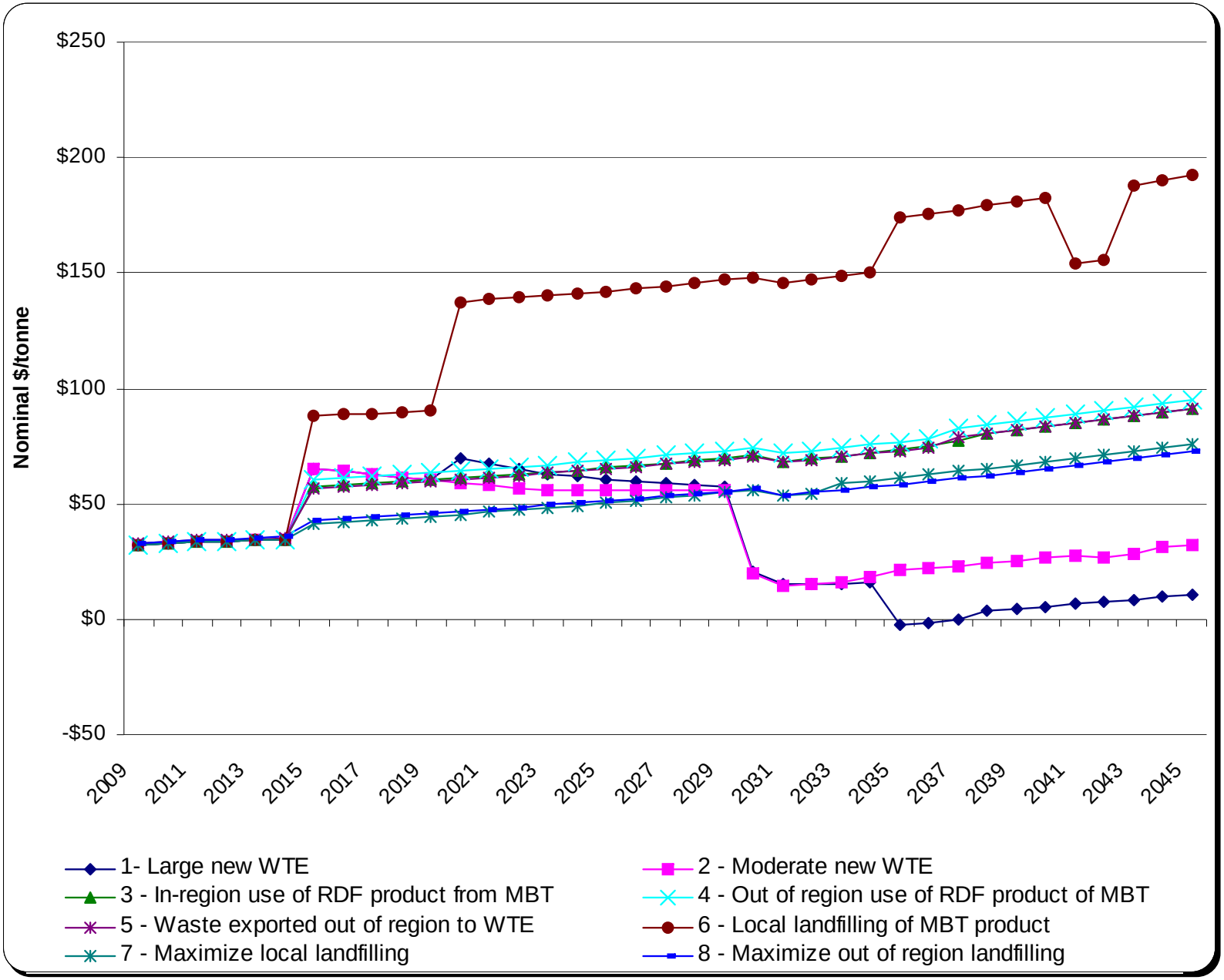
Observations on Levelized Costs in Base Case

- Scenarios with more WTE are 3% to 17% less costly than scenarios with a landfill focus
- Scenarios with RDF and/or out-of-Region facilities are slightly more costly than scenarios with landfill focus
- All scenarios are in similar cost range, except the MBT with landfill combination.
- The MBT and stabilized residual disposal scenario is substantially more costly than other scenarios:
  - Much higher processing requirements
  - No energy revenue from landfill gas
  - Only minor recycling revenue

Observations on Levelized Costs Sensitivities

- If there is no district energy and WTE produces electricity only, then landfill focus scenarios have edge
- If WTE scenarios in Region sell only half of the modeled district energy, then costs are similar to landfill focus
- If electricity price is lower than modeled in base case, then ranking does not change but WTE advantage is smaller
- MBT with stabilized residual disposal remains highest cost scenario by a large margin

Accounting Costs



Comments on Accounting Costs

- Scenarios with new WTE have higher investment and higher initial costs
- After capital paid off, WTE scenarios have lower costs because of energy revenue
- MBT with stabilized product disposal has continually escalating costs because
  - There are no offsetting revenues
  - Additional capital investment needed to keep pace with growing waste volumes

THANK YOU