Waste to Energy Business Case Analysis

Discussion of Initial Results

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October 18, 2011, Whitehorse, Yukon

Study Purpose

- Displace the use of diesel for generating electricity
- Assess potential for generating firm local power using municipal solid waste (MSW)
- Include feasibility of providing district energy to Whitehorse

What Does Waste to Energy (WTE) do?

- Resource recovery from the solid waste stream
  - Energy –Electricity from local resources
  - Energy - District heat from local resources
  - Recycling - Metals
- Waste volume reduction, preservation of landfill space
- Destruction of contaminants
- Dealing with waste here and now
- Reduce GHG
- Job creation

The role of thermal treatment

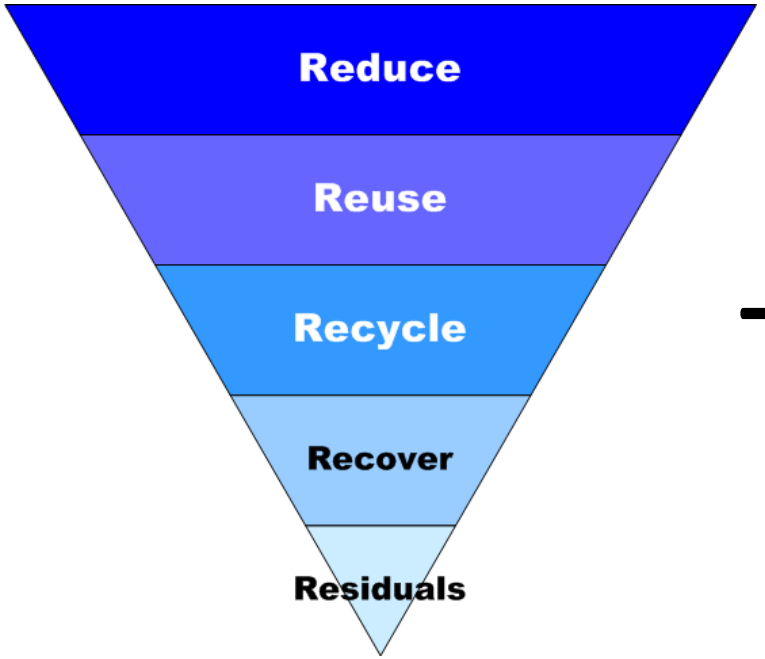
- One tonne of waste can deliver 400 to 700 kWh of electricity to the grid
- One tonne of waste has the same energy as one barrel of oil, or a quarter tonne of coal
- 24 tonnes of waste can provide all the electricity for a Canadian home for a year

What Does WTE NOT do?

- Does NOT replace the need for a landfill
- Does not take materials away from recycling
- Does not contaminate the atmosphere
  - Most highly regulated form of combustion
  - Generally lower emissions than from burning wood or oil
- Does not cause health issues
  - International studies show no health concerns around modern WTE plants

WTE and Recycling

- The application of the waste management hierarchy **AND** local priorities



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Financial

Environmental/GHG

Social/Community

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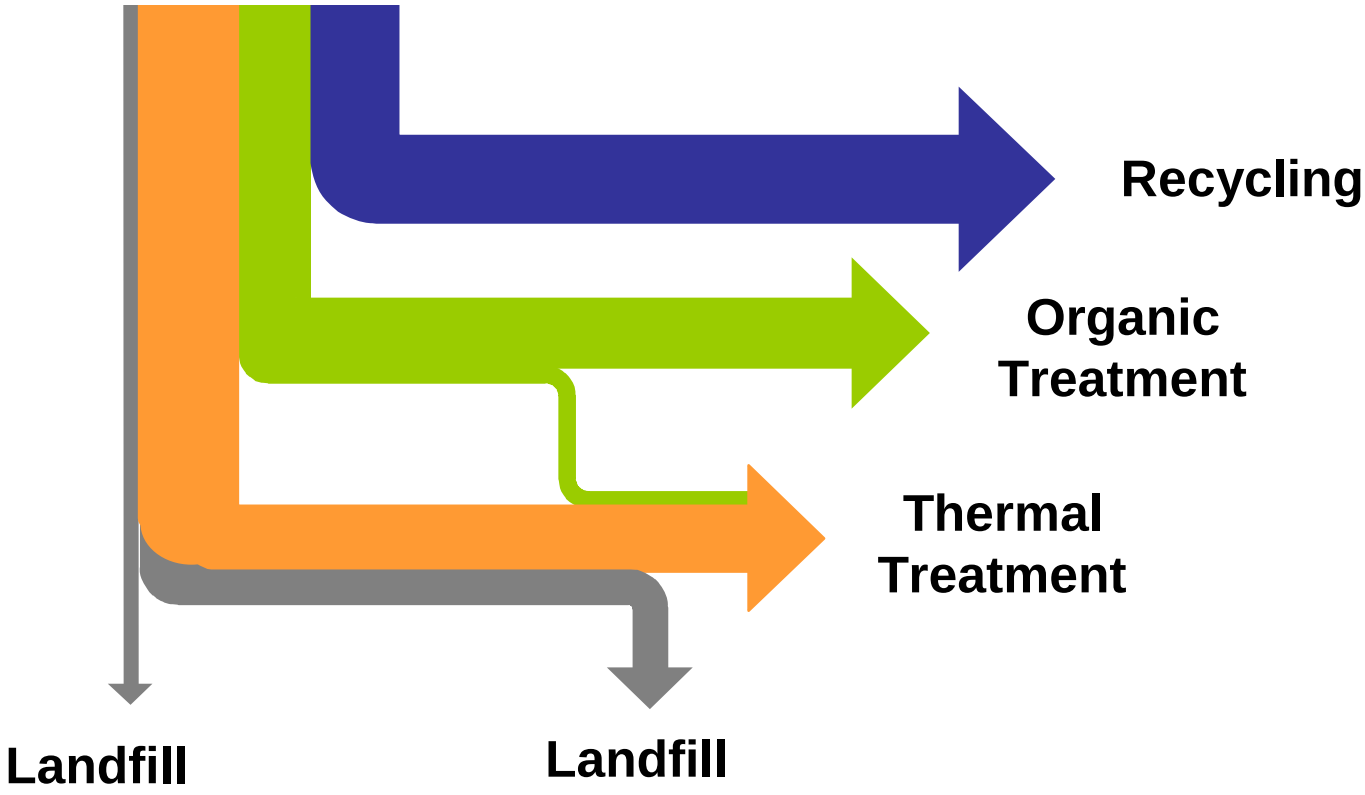
The Role of WTE in an Integrated System



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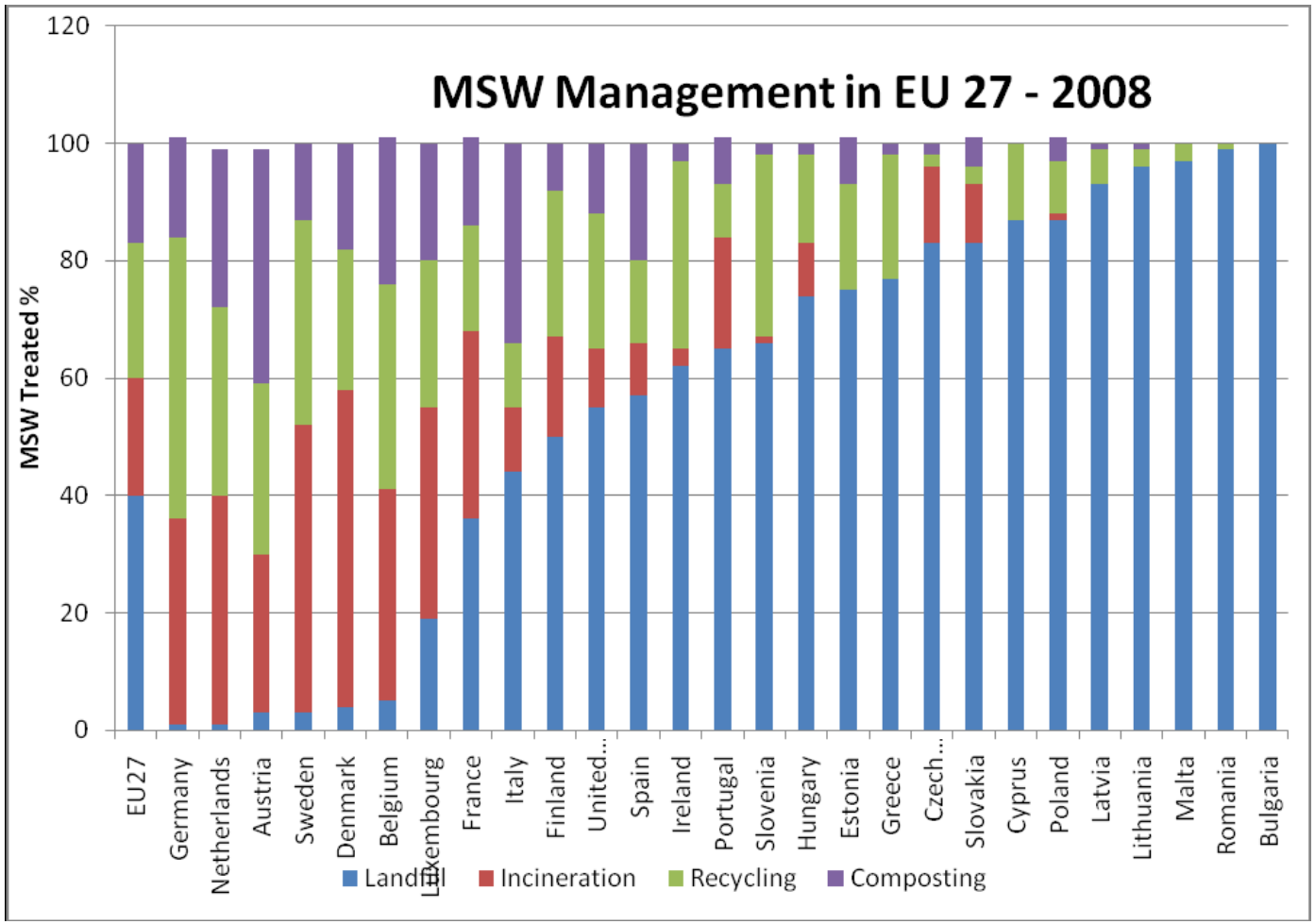
Integration of WTE and Recycling

- WTE would use only feedstock that is not recycled
- WTE integrates well with recycling, composting and biogas
- Experience in the USA and Europe shows that countries with highest WTE also have highest recycling/composting and lowest landfill

Integration of WTE and Recycling



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How WTE Works

- Technologies offer different ways of releasing the energy in the waste
  - Conventional combustion/WTE
  - Advanced thermal treatment (Gasification/pyrolysis, plasma systems)
- WTE systems are essentially thermal power plants using waste as fuel instead of wood, propane or fuel oil/diesel

Chosen Technology for Study

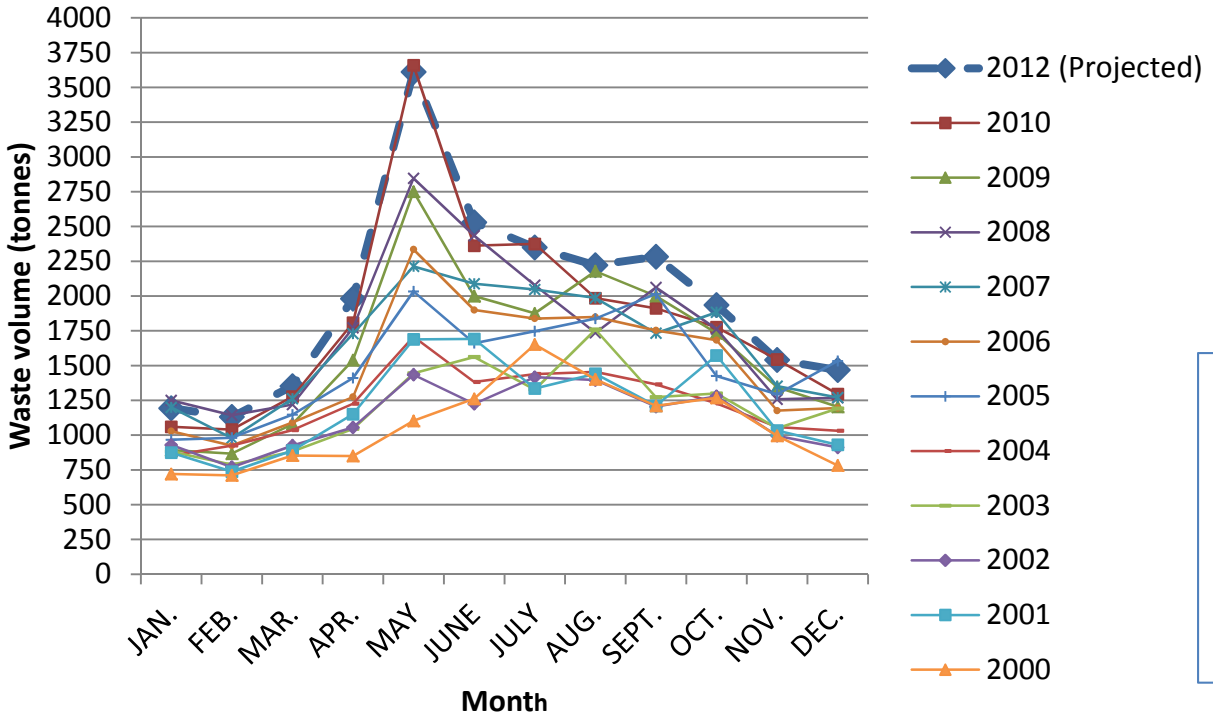
- Conventional Combustion
  - Proven
  - Statistical cost and operations data
  - Used for study purposes only
- Advanced technologies potential for future
  - Higher energy recovery
  - Greater flexibility
  - Currently unproven
  - Little data

Approach

- Assess waste feedstock
  - Quantity
  - Quality
  - Alternatives/biomass
- Review technologies
  - Select technology for analysis
- Develop scenarios
- Financial model and analysis

Waste Variability Issues

MSW Generated in Whitehorse



Can we utilize biomass (wood) to fill in the gap during Winter?

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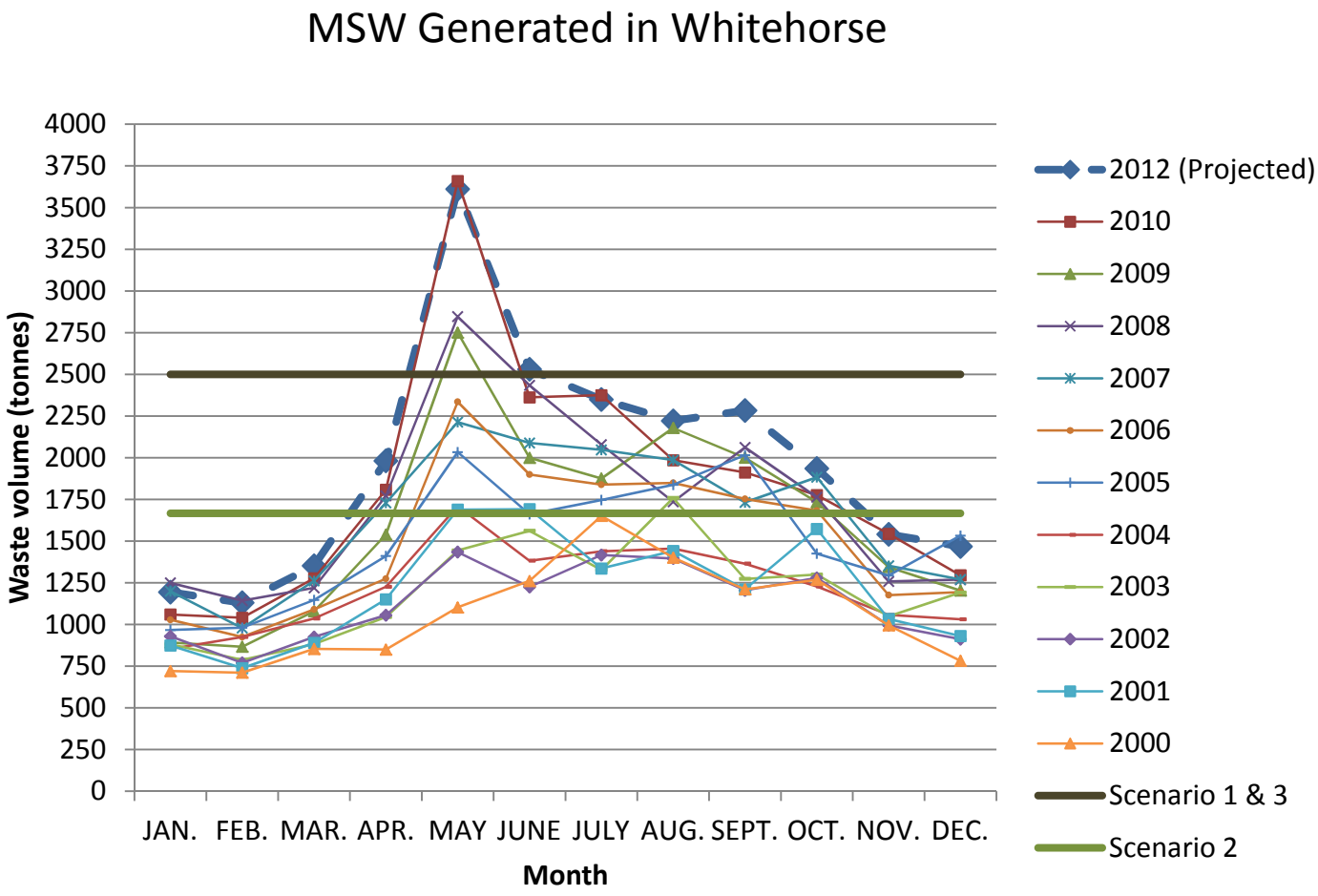
Scenarios

- Scenario 1 – Maximum MSW use
  - Maximize the availability of MSW
  - Penalty is underutilized equipment
- Scenario 2 – Maximum use of equipment
  - Size WTE plant to operate near capacity
  - MSW only
- Scenario 3 – Maximum generation of power
  - Supplement MSW with biomass

Scenarios – Design Capacity



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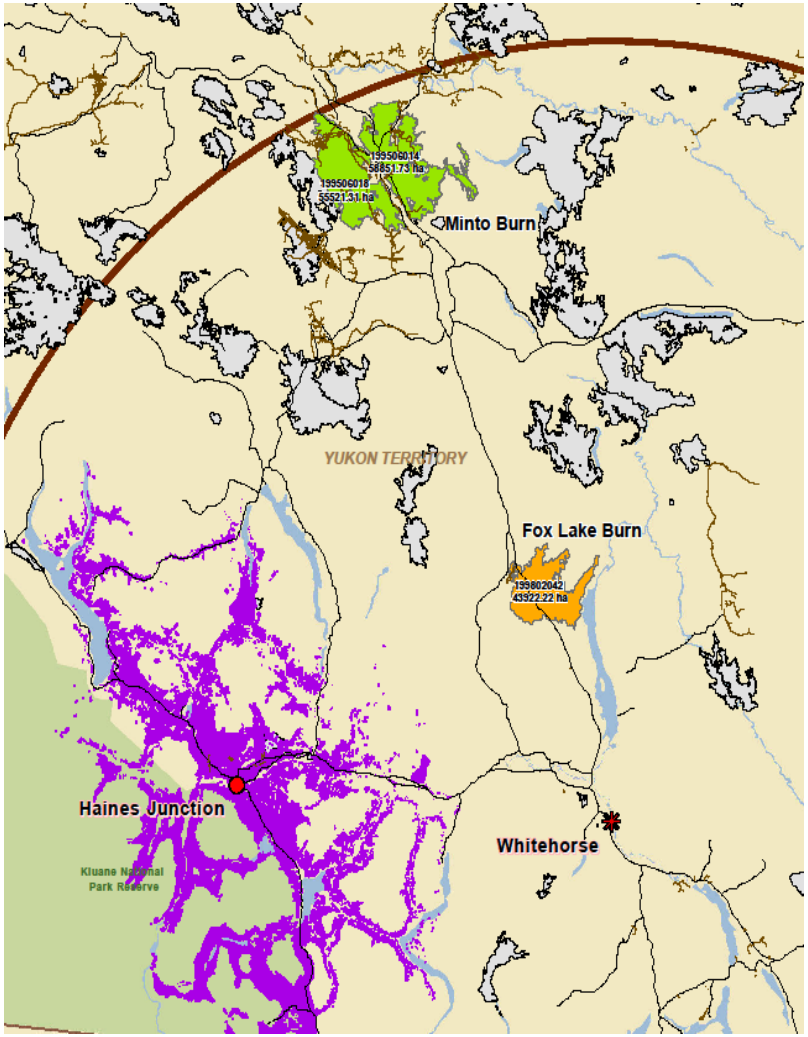
Wood Biomass Options

1. Utilize saw mill and harvest residues from Haines Junction mill
   - Currently not utilized
   - Price and security of supply uncertain
2. Harvest dead, standing timber
   - Fire-killed wood
   - Beetle-killed wood in Haines Junction area
3. Currently open burned or buried wood waste

Biomass Sources and Costs



- Significant quantity of biomass (fire-kill and beetle-killed wood) potentially available within 250 km radius of Whitehorse
- Estimated cost: $150 / OD tonne delivered to Whitehorse

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Recycling Assumptions

- Current waste diversion about 20%
- Waste continues to increase each year
- WTE demand for feedstock remains steady as capacity remains constant
- Re-calculation when recycling study complete and programs committed

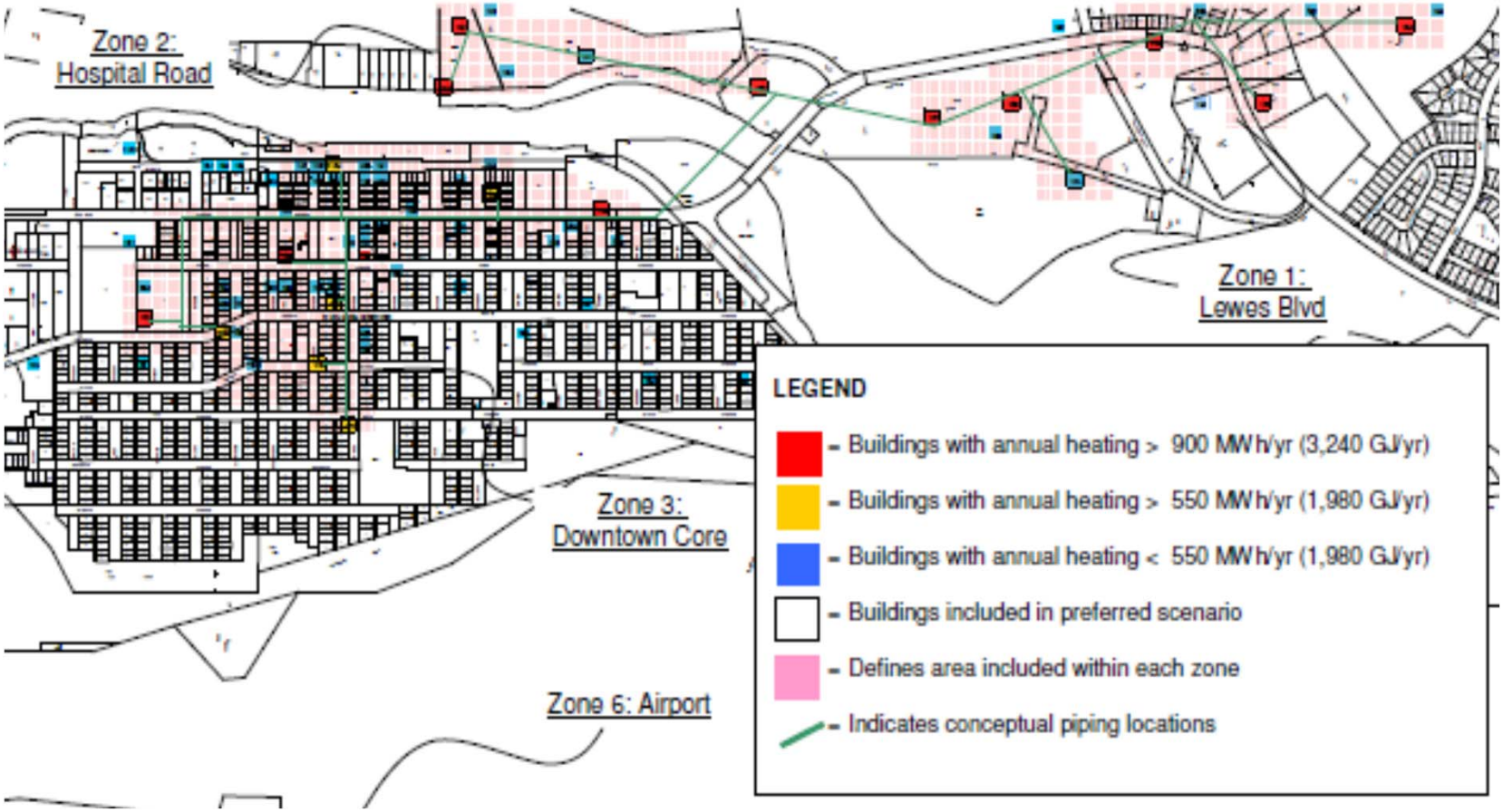
Maximize Energy Utilization

- District heat sales increase energy utilization beyond electricity
- Displace both fossil fuels and electrical demand from heating
- Provides a low carbon, local energy source shielded from increasing fossil fuel costs

Markets for Heat

- District energy in Whitehorse
- Based on results of Stantec study
- Zones 1 (Riverdale) and 2 (Hospital District) and new municipal services building selected as heat markets
  - Best proximity to potential plant site
  - Highest heat demand density

District Energy Zones (Stantec)



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Base Case Results

Scenario	Electricity Cost $/KWh	Electricity Production MWh/y	Comments
1	$0.18	13,920	Maximum use of MSW as fuel
2	$0.16	10,840	Best utilization of equipment burning only MSW
3	$0.16	17,100	Combination of maximum use of MSW as fuel, supplemented by biomass to get best utilization of equipment and generation of power

Sensitivity to District Energy

Scenario	Base Case (w/ District Energy) Electricity Cost $/KWh	Electricity Only Electricity Cost $/KWh
1	$0.18	$0.30
2	$0.16	$0.31
3	$0.16	$0.27

Results

- Scenario 3 preferred:
  - Greatest amount of constant power and heat
  - High flexibility due to dual fuel
  - Supports enhanced recycling
  - Displaces highest amount of diesel and heating oil

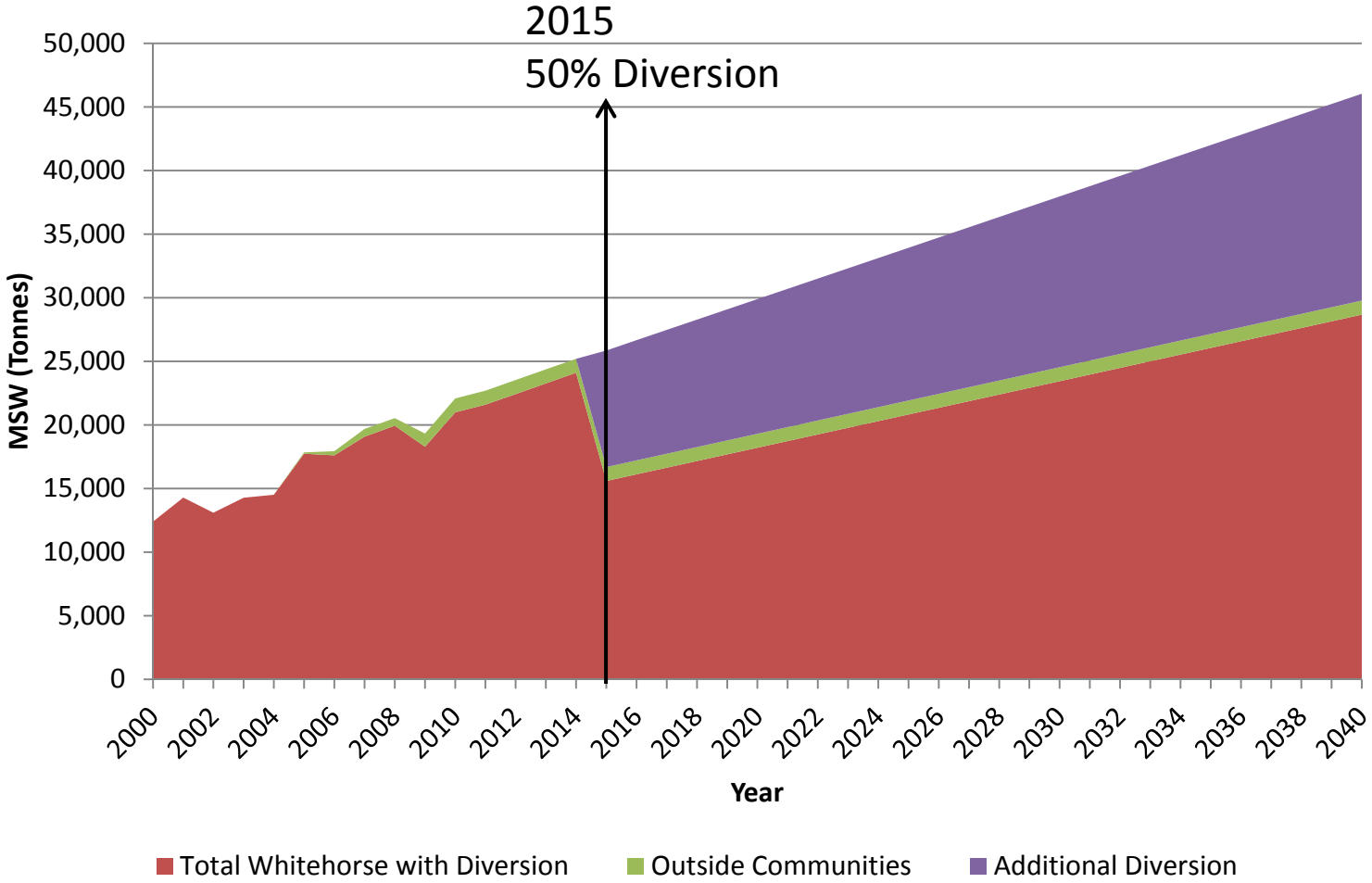
Enhanced Diversion Scenario

- City of Whitehorse Solid Waste Action Plan 1998 "The goals are to reduce waste by 50%"
- Yukon Recycling Review currently underway
- Additional analysis undertaken to examine impact of 50% diversion on WTE.

Key Assumptions

- Diversion rate increases from approximately 20% (today) to 50% by 2015
- Waste growth in Whitehorse projected based on trends from 10 year tipping data
- Waste from outside communities does not grow
- WTE facility is scaled to accommodate 50% diversion scenario

Waste Projections with Recycling



- Outside Communities: Teslin, Marsh Lake (2005), Mt Lorne (2005), Deep Creek (beginning 2009), Carcross and Tagish (Nov 2009), Johnsons Crossing (August 2011), Braeburn (August 2011), Champagne (September 2011)

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Waste Potentially Available to WTE

Waste Stream	Report Scenario Current Diversion 2012 (TPa)	Enhanced Diversion 2015 (TPa)
MSW Generated within the City of Whitehorse†	23,595†	15,588
MSW Generated outside Whitehorse	2,669*	1,100
Tires	299	-
Waste Oil	239	-
Abattoir Waste	250	-
Total MSW	27,050	16,688
Biomass	3,790 ODT	5,770 ODT

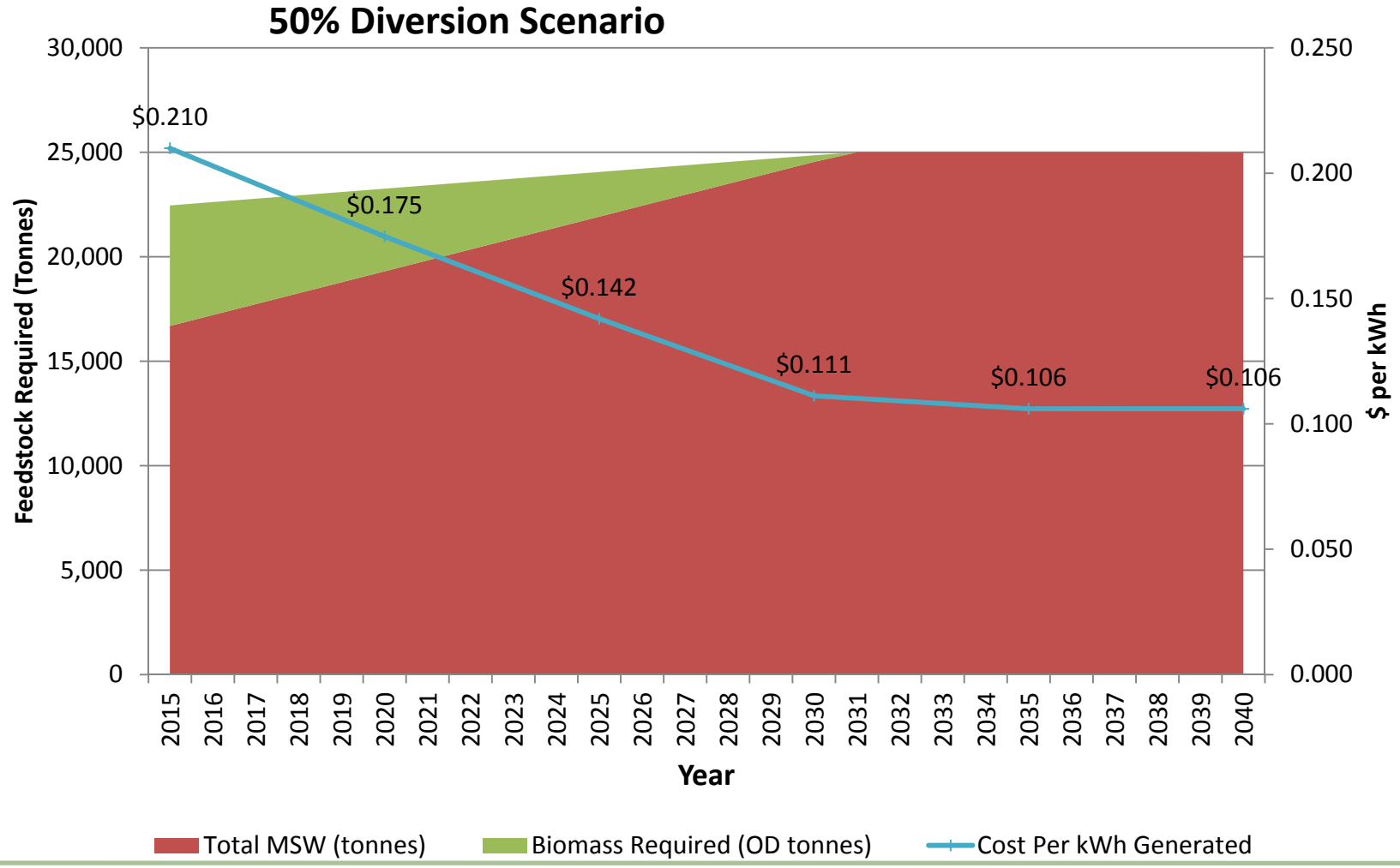
† - MSW waste volumes projected to 2012 based on 2000-1010 tipping data

* - unconfirmed estimate includes: Mount Lorne, Marsh Lake, Teslin, Deep Creek, Carcross , Tagish, Johnson's Crossing (From EBA 2009)

Scenario 3 – MSW & Biomass

	Scenario 3 Current Diversion Rate	Scenario 3 50% Diversion by 2015
Capacity	30,000 TPa	25,000 TPa
Power Produced	17,100 MWh (2.2 MW)	13,300 MWh (1.7 MW)
Cost of Power	$0.16/kWh	$0.21/kWh

Cost of Power Over Time



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Next Steps

- Confirm MSW and Biomass availability and Design Basis
- Evaluate the impact of WTE on landfill operating costs
- Identify and evaluate potential site locations and district energy opportunities
- Refine business case analysis
- Stakeholder engagement


Questions?