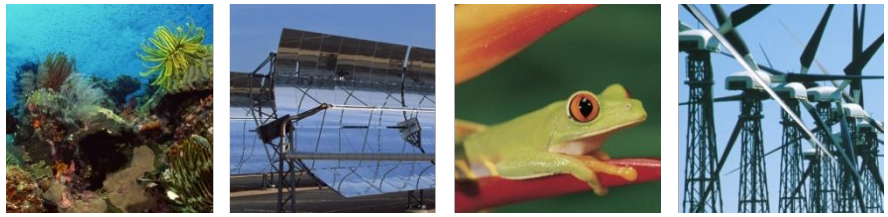

Integrated Waste Management as a Climate Change Stabilization Wedge

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Overview

- Introduction
- Business as Usual (BAU) Scenario
- Wedge Scenario
- Results
- Conclusions

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Covanta Overview

- Covanta Holding Corporation is a publicly-traded company on the NYSE (CVA)
  - Year 2008 operating revenues of $1.66 billion

- World's leading Energy-from-Waste (EfW) Company
  - United States, Europe & Asia
  - 38 EfW facilities
  - Over 8 million mega-watt hours/year
  - 17 million tons of waste/year

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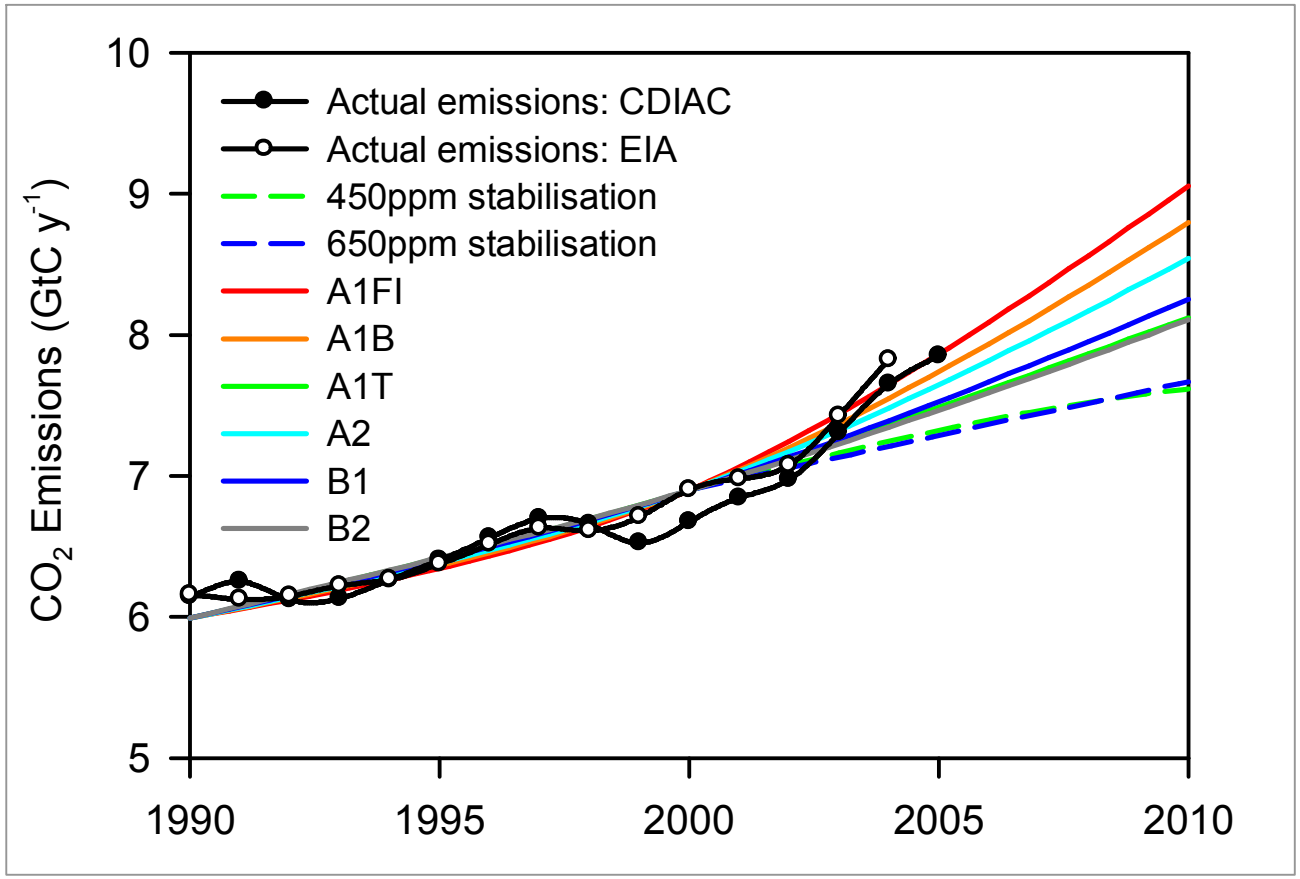
What's the Problem?



Source: Dr. ***Thomas J. Wilbanks***

What's the Solution?

- Stabilization Wedges
- Integrated Solid Waste Management:
  - Recycling
  - Energy from Waste (EfW)
  - Advanced Landfilling

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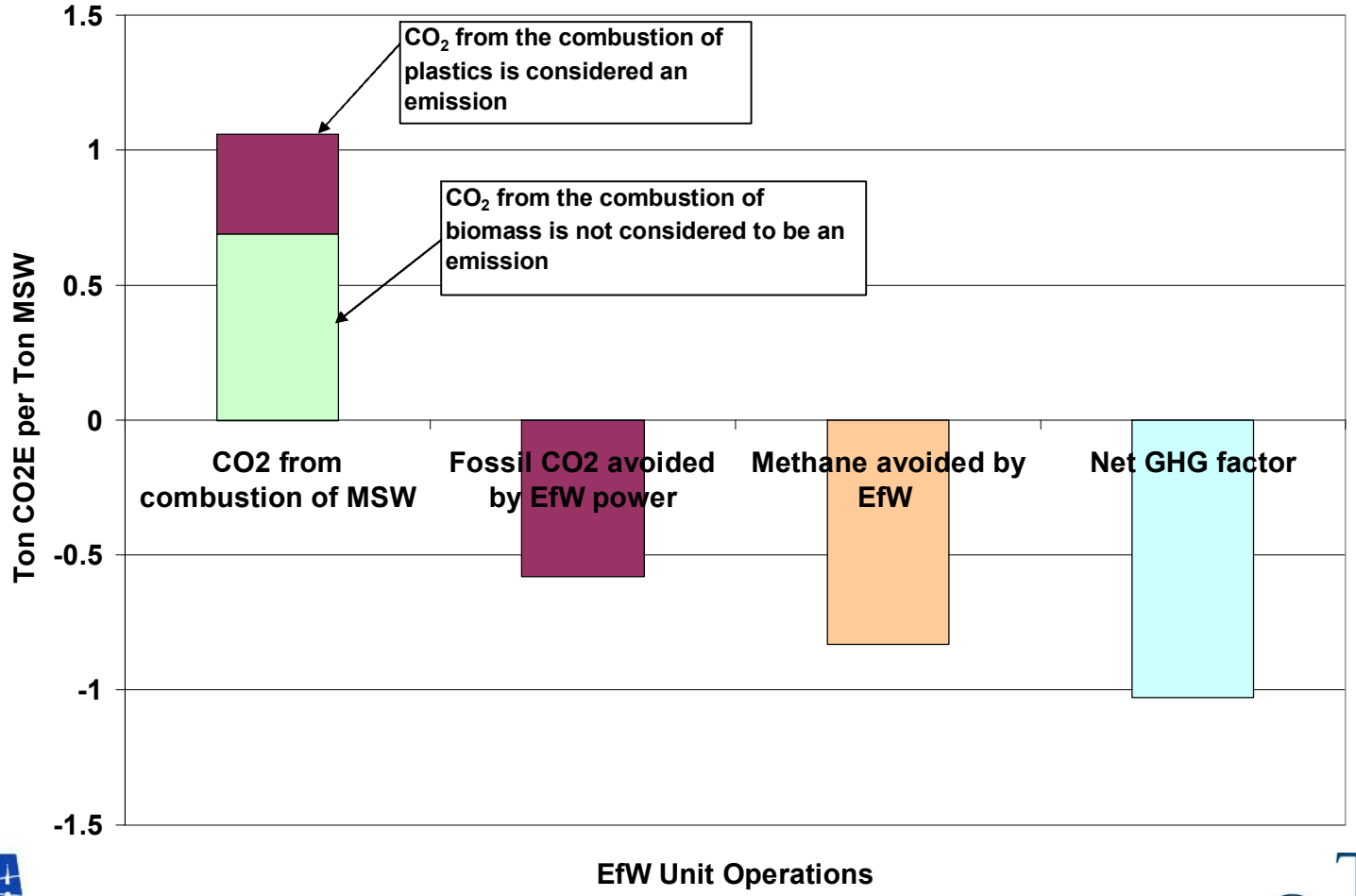
How Does EfW Reduce GHG Emissions?



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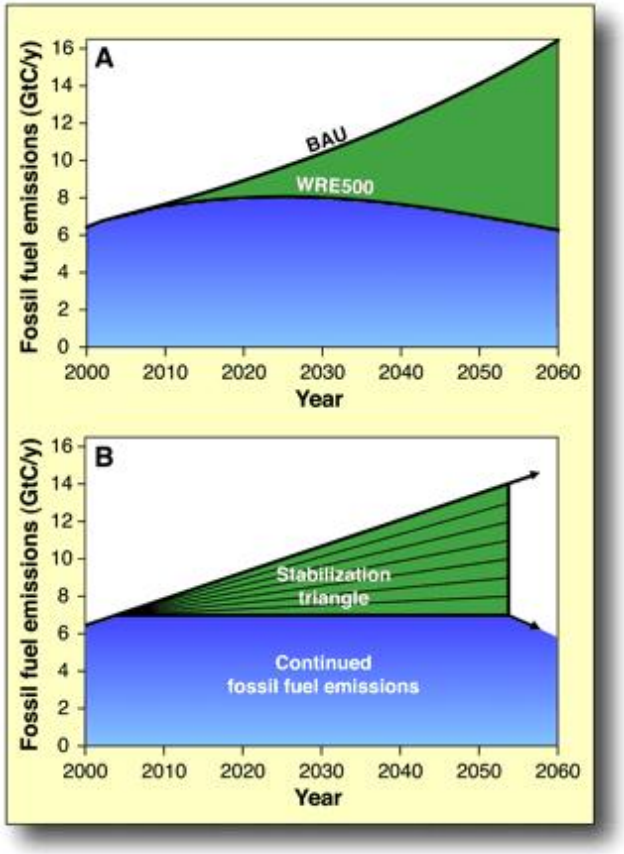
Wedge Introduction

- 2004 *Science* article by Drs. Pacala and Socolow (Princeton University) introduced the concept of the stabilization triangle
- 7 gigaton of carbon per year (7 GtC/yr) reduction needed by 2054 versus BAU
- Subdivided into 7 manageable wedges of 1 GtC/yr each
- Seven wedges together would *stabilize* world-wide greenhouse gas *emissions* at today's emission rate



S. Pacala et al., Science 305, 968 -972 (2004)

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Originally Proposed Wedges and the Waste Wedge

Wedge	*Examples*
Energy Efficiency	Vehicles, buildings, power plants
Fuel Shift	Coal to nuclear
CO2 capture and storage	
Nuclear fission, renewable energy	Wind, photovoltaic, biogas
Forests and agricultural soils	Reduced deforestation and tillage

An integrated waste management system is a new and novel wedge approach:
- *Recycling, energy-from-waste and advanced landfilling have not been addressed*
- *A life cycle assessment that includes both CO2 and CH4*

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BAU Scenario

Business a Usual (BAU) – increased GHG emissions due to:

- Increasing population (IPCC and United Nations data)
- Increasing waste generation (IPCC)
- Increasing GHG emissions due to use of current MSW options

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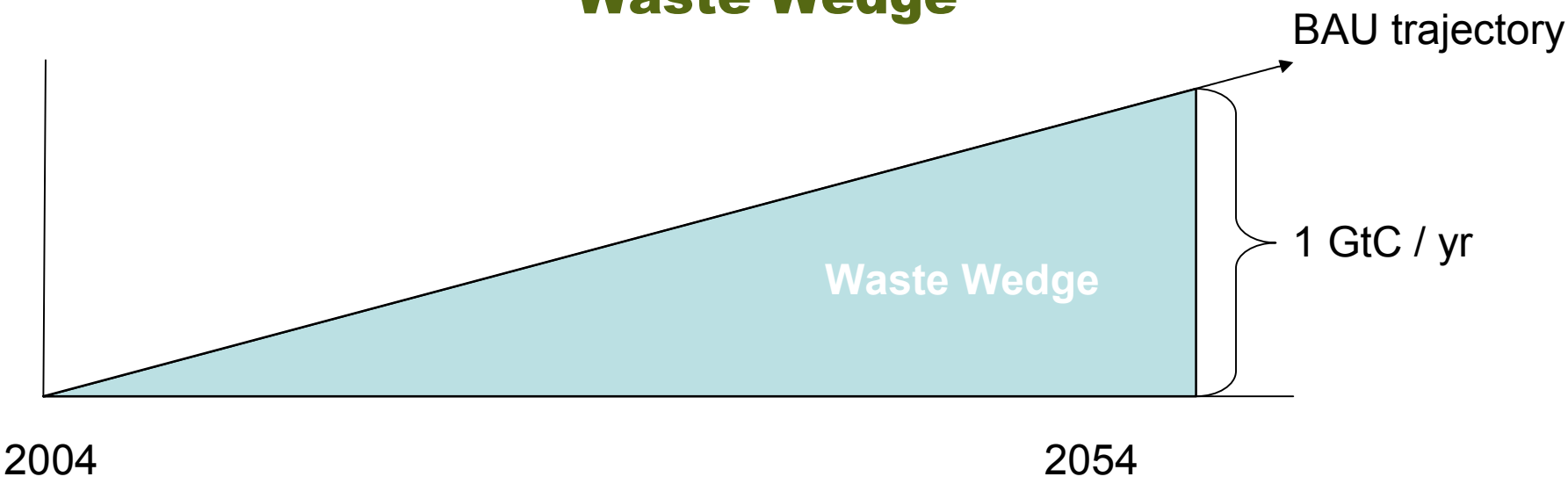
Waste Wedge



The Wedge Scenario considers how alternative allocations of waste to various options can reduce GHG emissions

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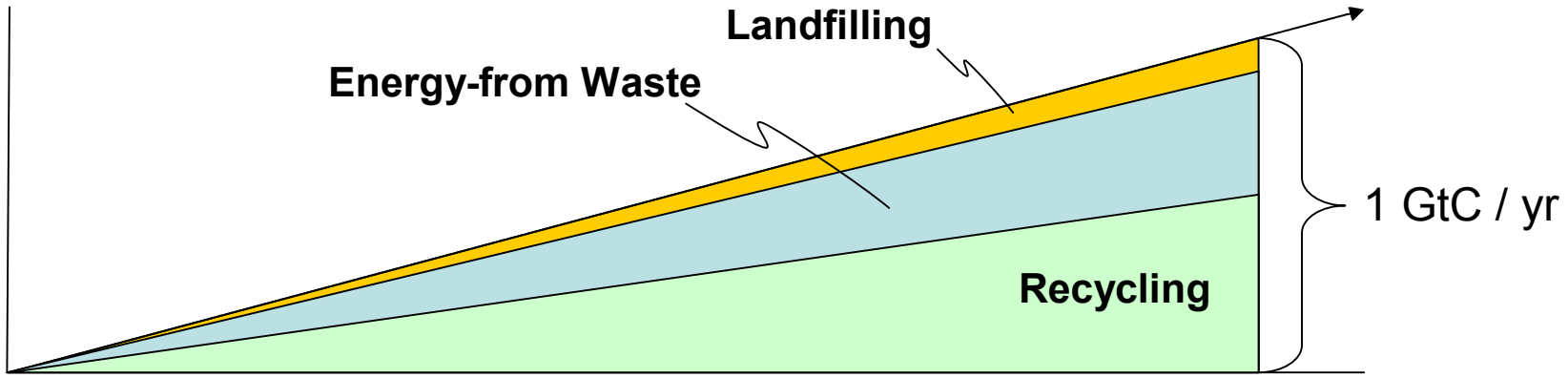
Waste Wedge - Components



The Integrated Waste Management Wedge consists of:

- Expanded recycling
- Expanded energy-from-waste (EfW) with improved thermal efficiency
- For waste remaining: increased LFG recovery efficiency and LFGTE

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Basis of Waste Wedge

Source: Indiana DEM

- Allocation of MSW followed hierarchy
- Goal to maximize energy savings and recovery
- EU hierarchy implemented thru Landfill Directive is law- therefore not part of the wedge.

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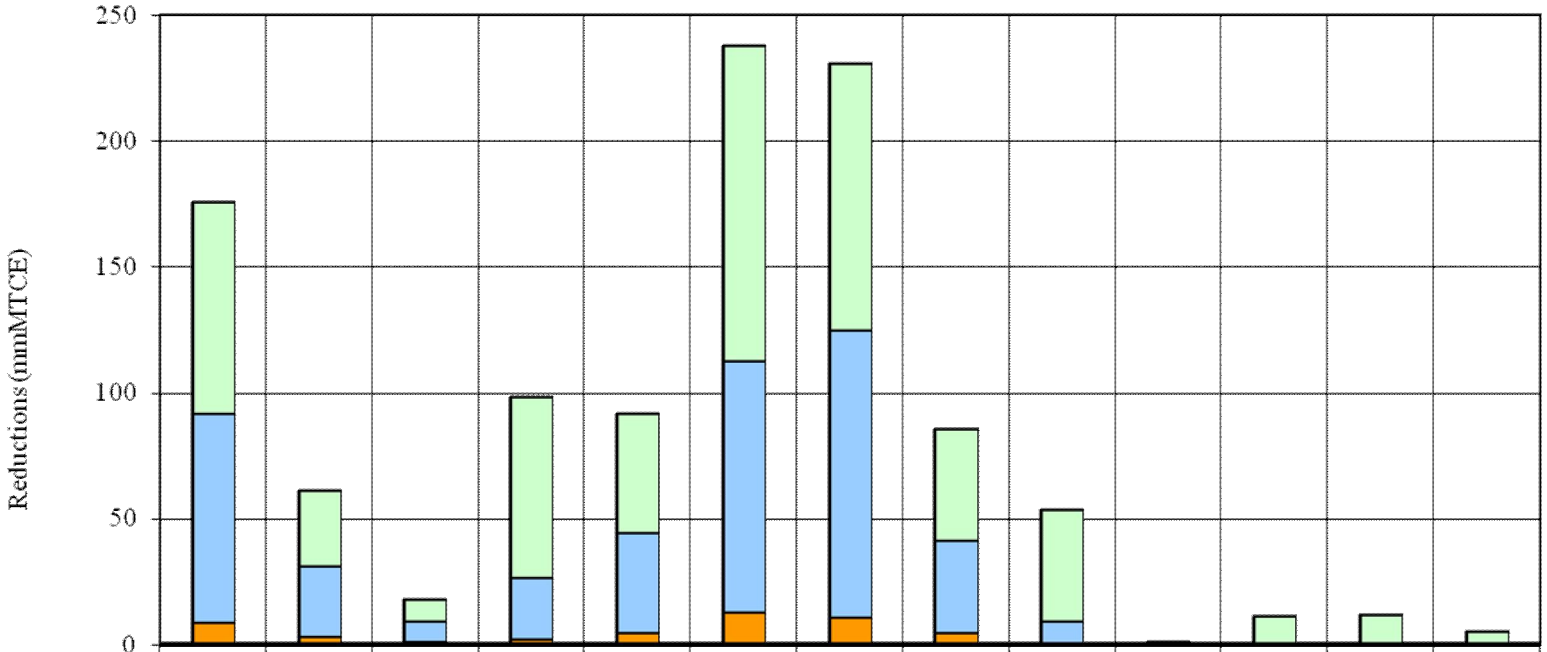
Wedge Reductions by Geography



	Africa	Middle East	Central America & Caribbean	N. America	S. America	E. Asia	S. Asia	SE Asia	E. Europe	N. Europe	S. Europe	W. Europe	Oceania
Recycling	84	30	9	72	47	125	106	45	44	1	11	11	5
WtE	83	28	8	24	40	100	114	37	9	0	-1	-1	0
Landfill	8	3	1	2	5	13	11	4	0	0	0	0	0

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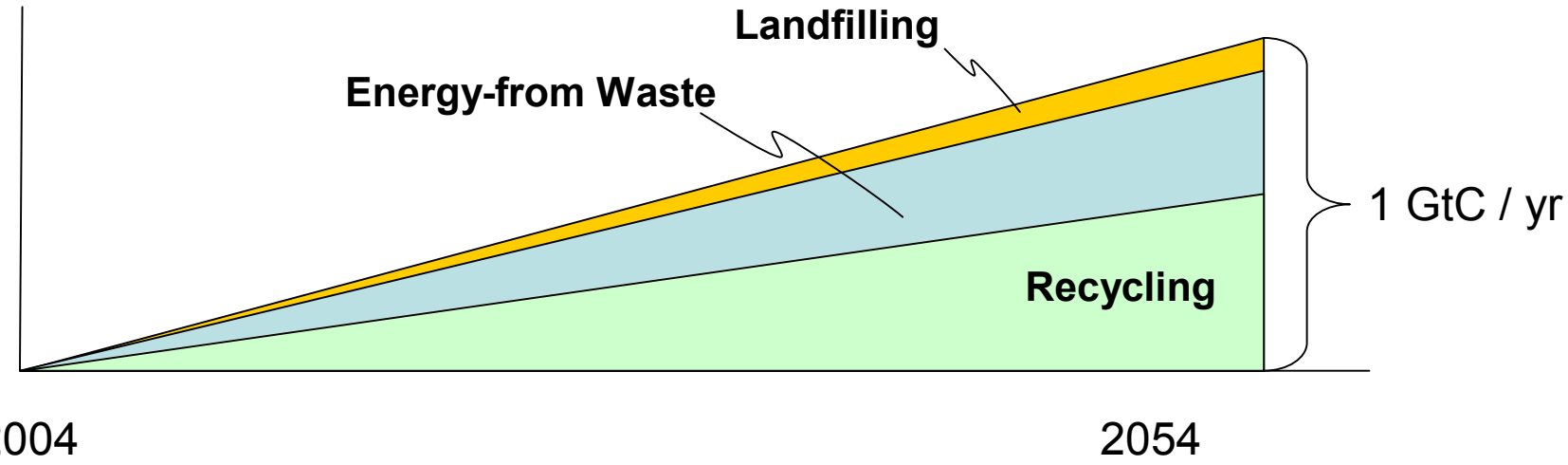
Sensitivity Analyses

Addressed Impact of:

- Changes in Waste Management Techniques
- Updated GWPs
- Forest Carbon Sequestration

On the Waste Wedge:



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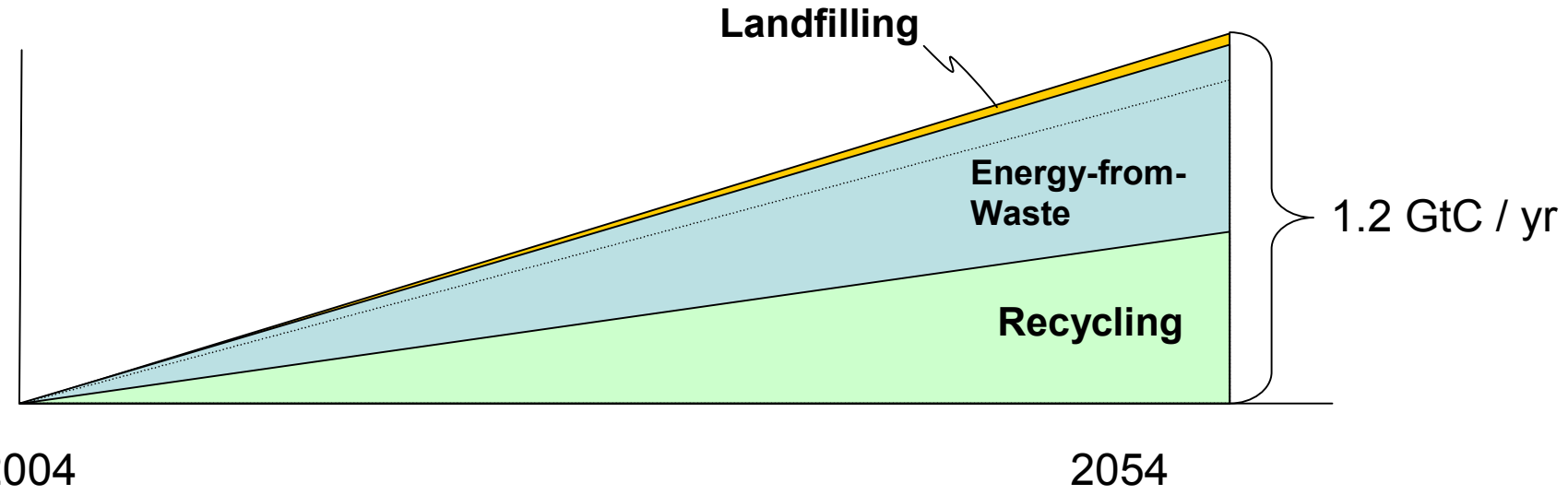
Sensitivity A – Expanded Energy-from-Waste

- The majority of MSW remaining after recycling allocated to Energy-from-Waste (combustion)



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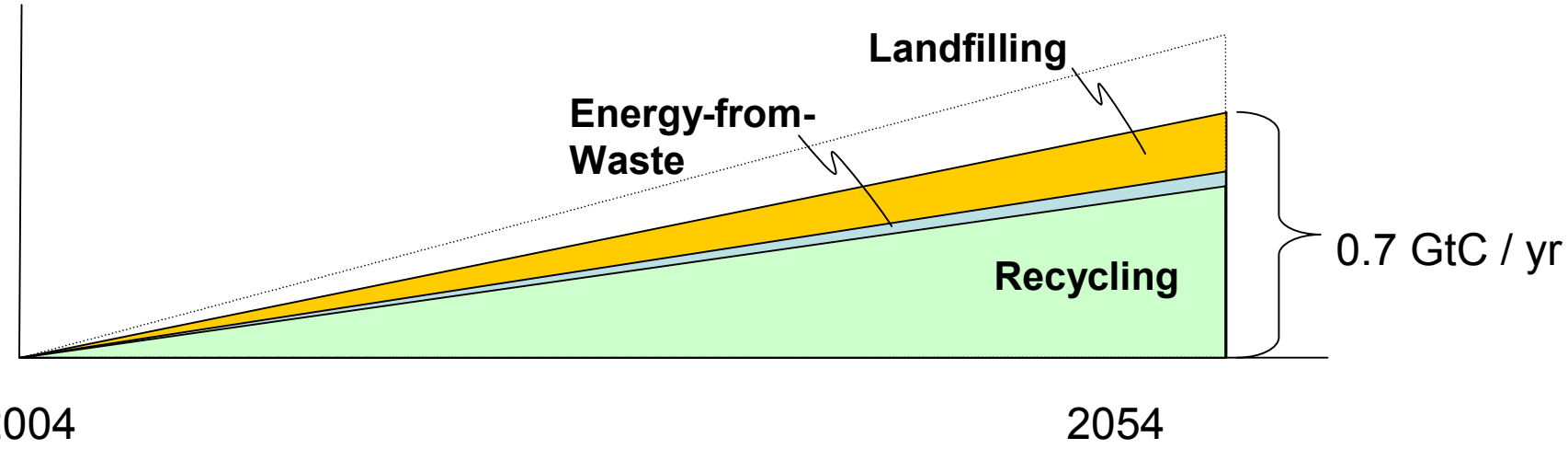
Sensitivity B – Expanded Landfilling

- The majority of MSW remaining after recycling allocated to landfilling



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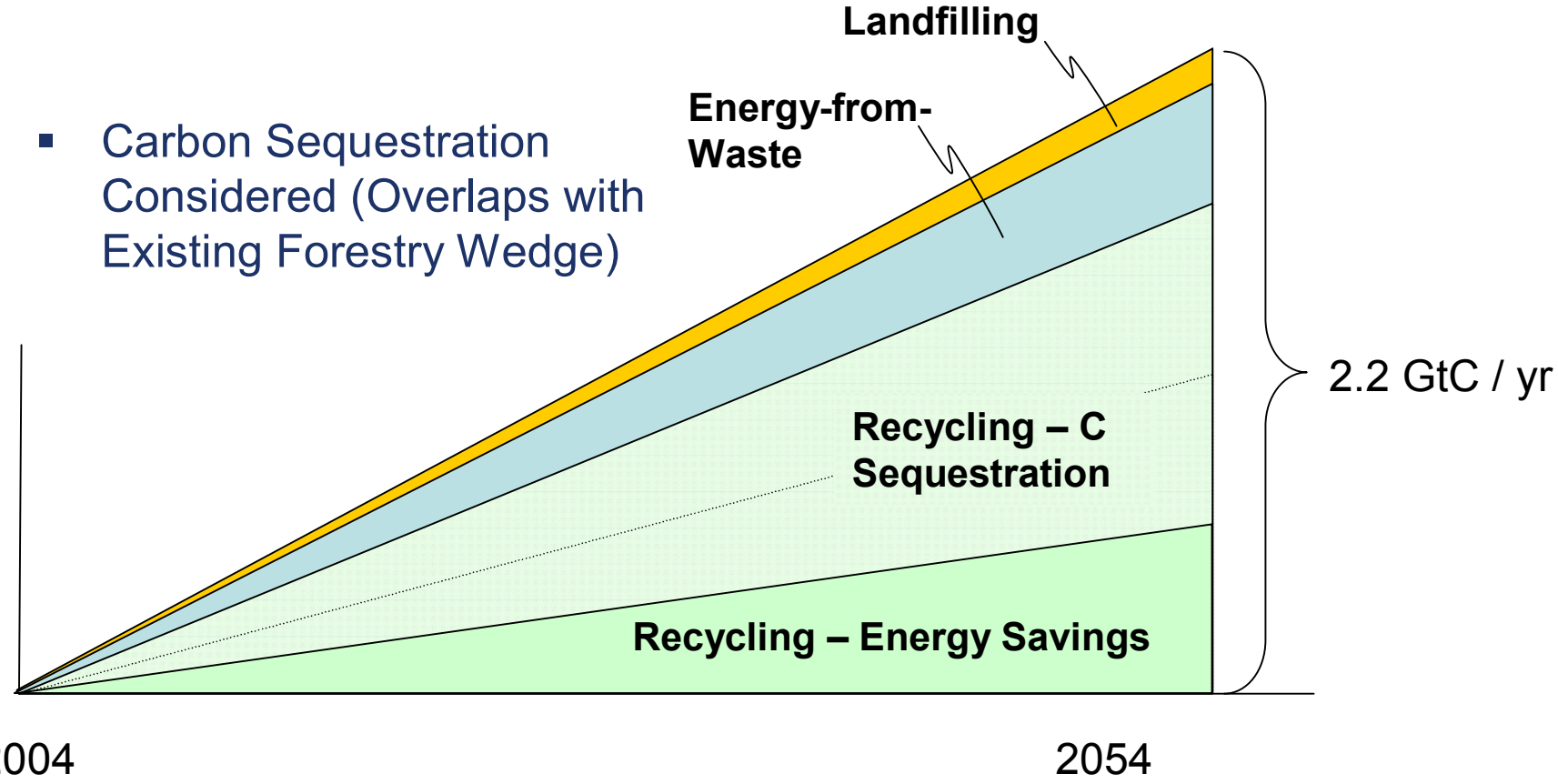
Sensitivity E – Carbon Sequestration

- Carbon Sequestration Considered (Overlaps with Existing Forestry Wedge)



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Sensitivity – All Analyses

		TPY as CO2e		
Scenario	**Total TPY**	**Recycle**	**EfW**	**Landfill**
Baseline	1079	589	442	48
A. Max. EfW	1182	589	568	24
B. Max. Landfill	736	589	16	131
C. Increase EfW efficiency	1091	589	455	48
D25. GWP of 25	1222	656	509	57
D72. GWP of 72	2911	1449	1298	164
E. C storage	2201	1711	442	48

Legend

A. Maintain Recycle Rate – shift MSW to EfW

B. Maintain Recycle rate – shift MSW to landfill

C. Maintain Recycle rate – increase thermal efficiency in Asia, North America

D. Change 100 year GWP of 21 for CH4 to 25 and 20 year to 72 per IPCC 4th Assessment Report

E. Include carbon storage attributable to recycling. Baseline only include energy savings.

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Wedge Conclusions

- An integrated solid waste management system following the waste hierarchy can achieve a wedge (1 GtC reduction) using currently available technologies
- The Baseline Wedge Scenario is a conservative (low) estimate with several variables that can create large increases
- The EU has the smallest potential for GHG mitigation in this sector – though a success for others to model
- Asia and the Americas offer the greatest potential for GHG mitigation from integrated solid waste management

Key Finding – the European Union's waste hierarchy is already creating large reductions in GHG emissions and is evidence that policies can drive the effective use of commercially available technologies if government is motivated.

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