

# Potential greenhouse gas mitigation from waste to energy options in Ireland

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# Outline

- GHG emissions and energy in Ireland
- Drivers for change: National and European Policy
- Waste Stream Composition in Ireland
  - Municipal Solid Waste (MSW) and Agricultural Waste
- Options and Potentials
  - Thermal Treatment and BioTreatment

# Greenhouse Gas Emissions

- Irelands Kyoto Target is 60 Mt CO<sub>2</sub> equivalent per annum
  - 13% above 1990 emissions of 53.2 Mt CO<sub>2</sub> equivalent per annum
- In 2003 emissions exceeded 66 Mt CO<sub>2</sub> equivalent per annum
  - 25% above 1990
- Recent projections indicate emissions will exceed 69 Mt CO<sub>2</sub> equivalent per annum
  - 30% above 1990 by 2008

(SEI, 2005)

# Energy in Ireland

- Energy (electricity sector) is responsible for 24.6% of national GHG emissions
  - Agriculture is responsible for 27% of national GHG emissions
- Largely based on fossil fuels such as coal, oil and peat
- 89% of the total (electricity, heat and transport) energy requirements are imported

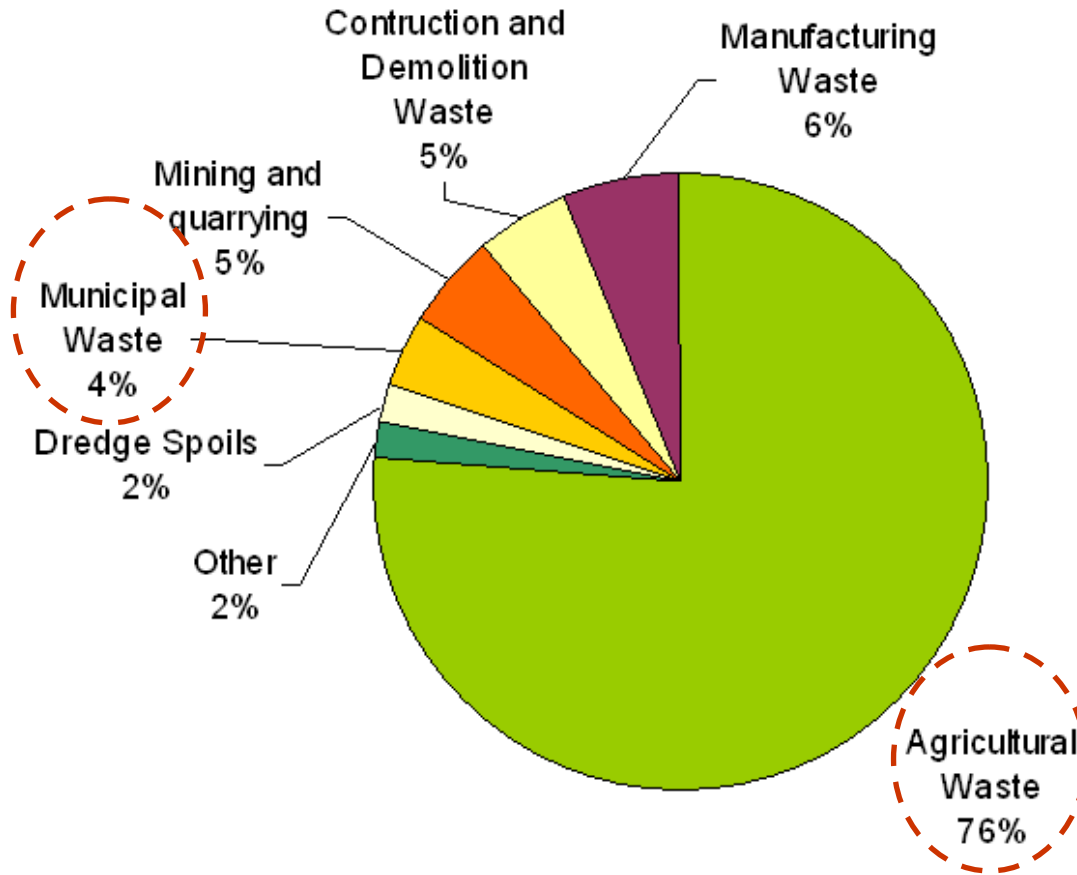
# European and National Energy Policy

- ***Ireland Green paper on sustainable energy (1999)***
  - Set the target of 500MW of electricity from renewables to be added in the period 2000 – 2005
- ***RES-E Directive on renewable electricity (2001)***
  - By 2010 it is Ireland policy to supply 13.2% of electricity from renewable sources

# Other Influential Policy

- ***EU Landfill Directive (1999)***
  - Maximum of 75% of total amount of biodegradable waste generated in 1995 can be landfilled by 2006
  - Decreased to 50% by 2009 and 35% by 2016
- ***EU Nitrates Directive (1991)***
  - Ireland committed to reducing water pollution from agricultural sources
  - National Nitrates Action Plan 2004

# Waste in Ireland



**Total of  
74 million tonnes**

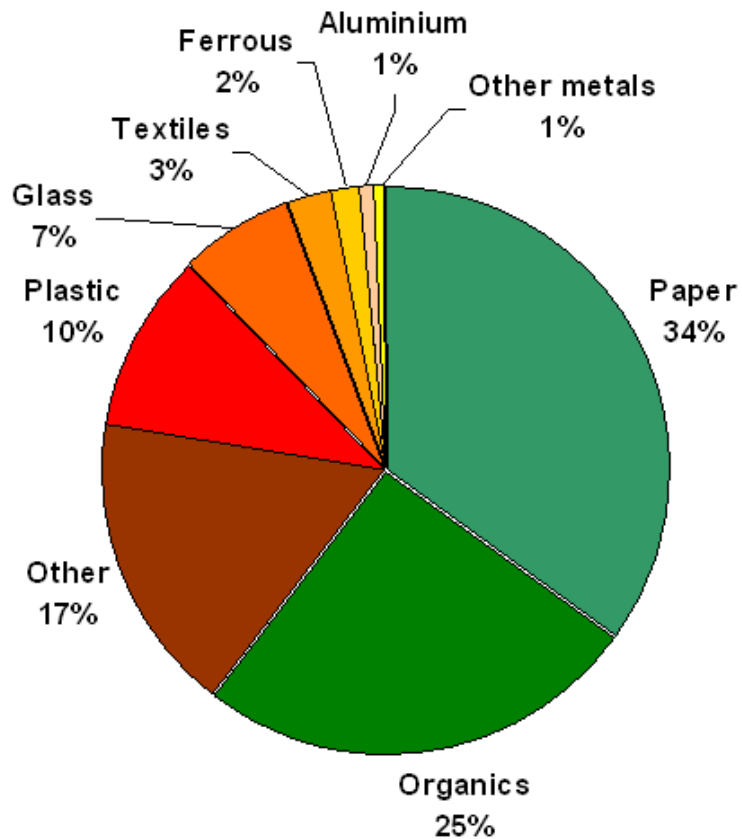
# Streams with High Biomass Composition

tonnes

- Municipal Waste 2.3 million
- Agricultural Waste 56 million



# Municipal Solid Waste (MSW) Composition

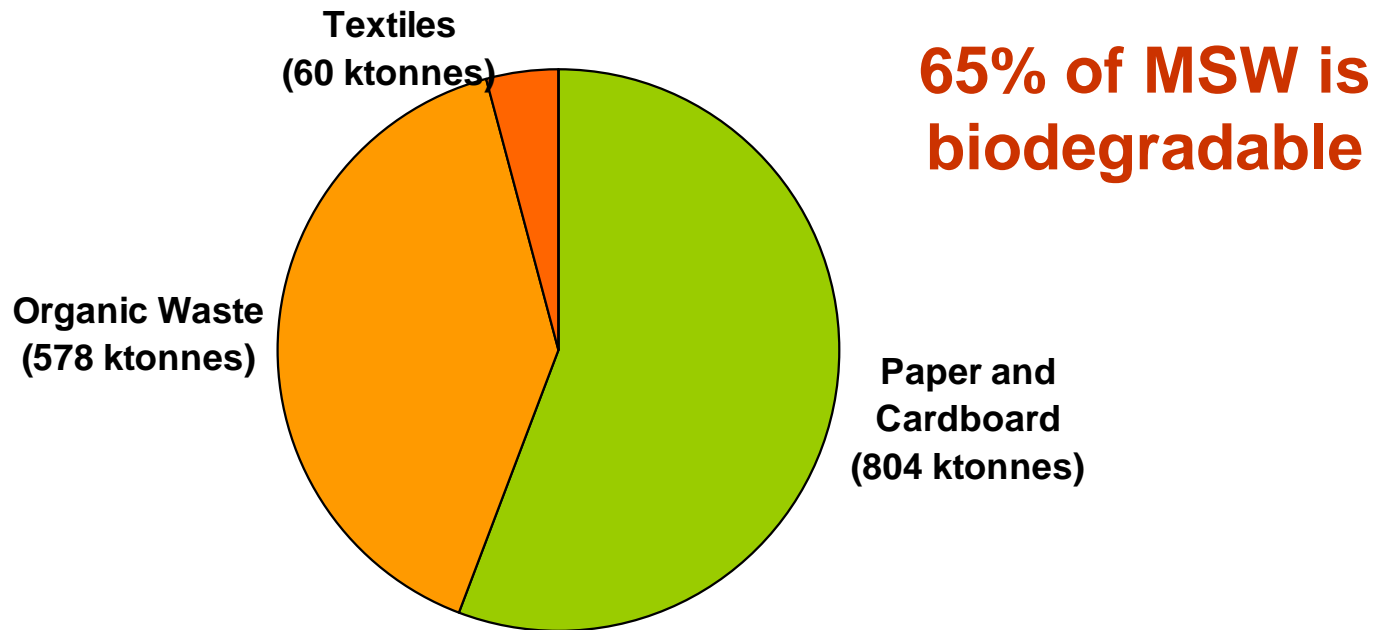


**Total of  
2.3 million tonnes**

(EPA, 2001)

# Municipal Solid Waste (MSW)

## Biodegradable Components



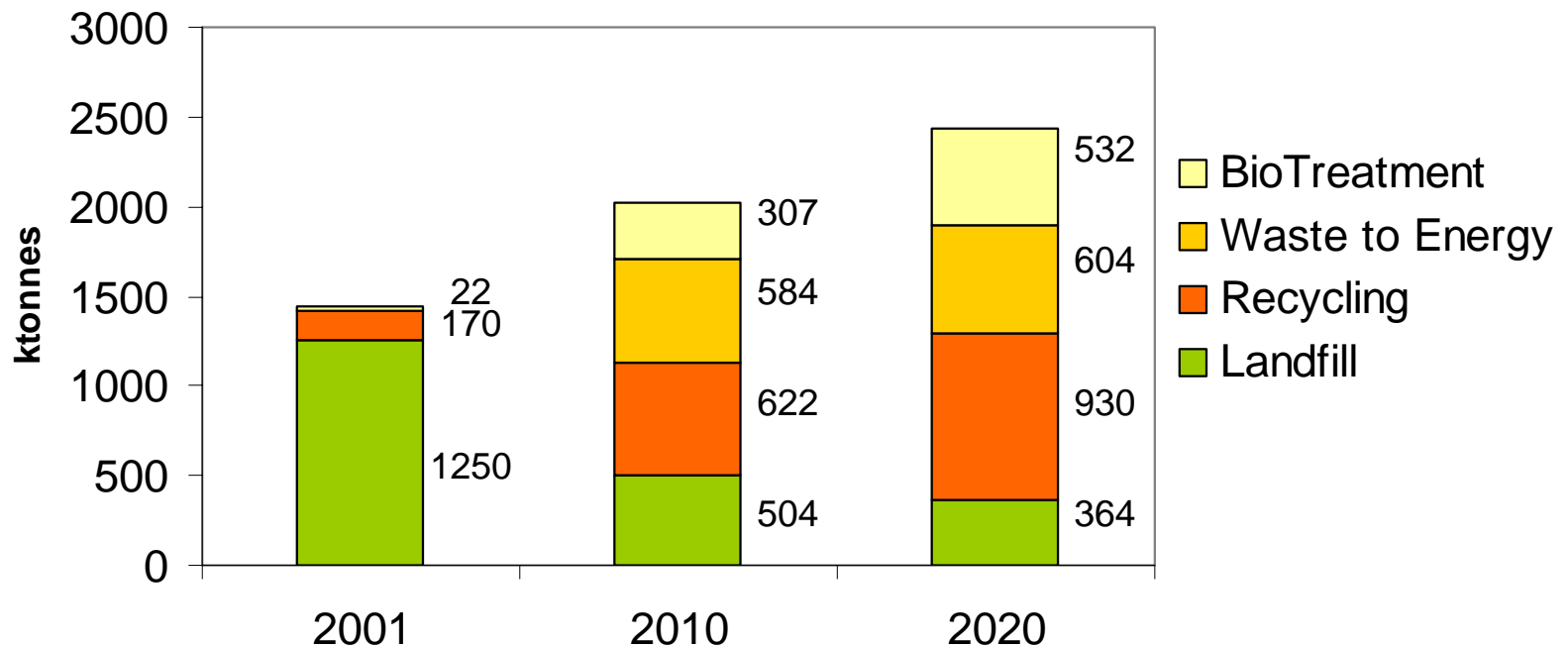
# Municipal Solid Waste (MSW)

## Disposal and Recovery Rates

	Disposal	Recovery		
	Landfill	Recycled	Waste to Energy	Bio-Treatment
Paper	79%	21%	-	-
Organics	96%	-	-	4%
Textiles	93%	7%	-	-

# Municipal Solid Waste (MSW)

## Disposal and Recovery Scenarios Paper, Organics and Textiles



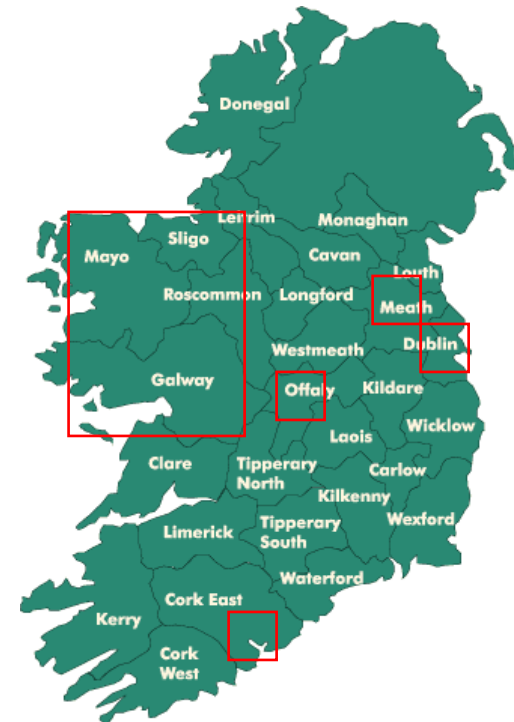
(SEI, 2005)

# Municipal Solid Waste (MSW)

## Proposed Thermal Treatment Plants

(Ktonnes '000)

- Dublin 890
- Mid West 260
- North East 212
- South East 270
- Connaught 330
- Total ~1.96 million tonnes



(EPA, 2004)

# Municipal Solid Waste (MSW)

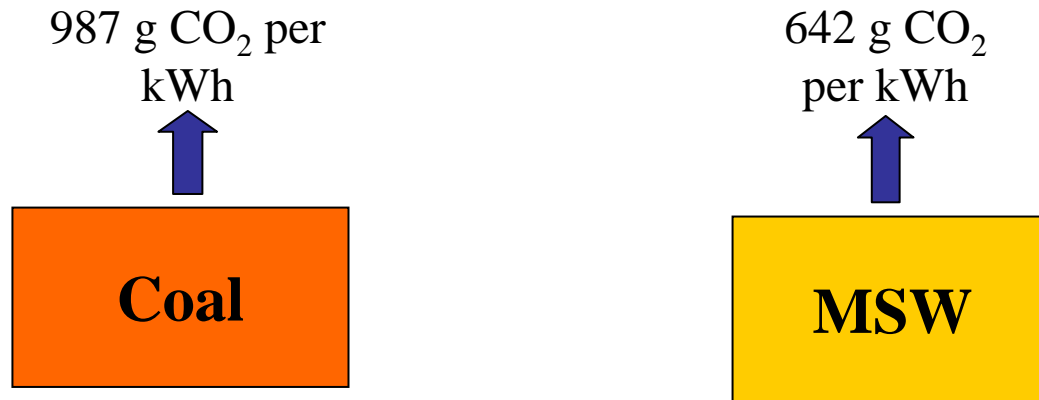
## Thermal Treatment Plant Example

- Process 150,000 tonnes per annum of MSW
- 14MW capacity, exporting 11MW to the national grid enough energy to support 16,000 homes  
([www.indaver.ie](http://www.indaver.ie))
- Approximately 65% of the waste stream is organic material (97500 tonnes per annum)

# Municipal Solid Waste (MSW)

## Lifecycle CO<sub>2</sub> Emissions

- 1833 g CO<sub>2</sub> per kWh produced from MSW
- 642 g CO<sub>2</sub> per kWh derived from fossil sources (i.e. plastics)



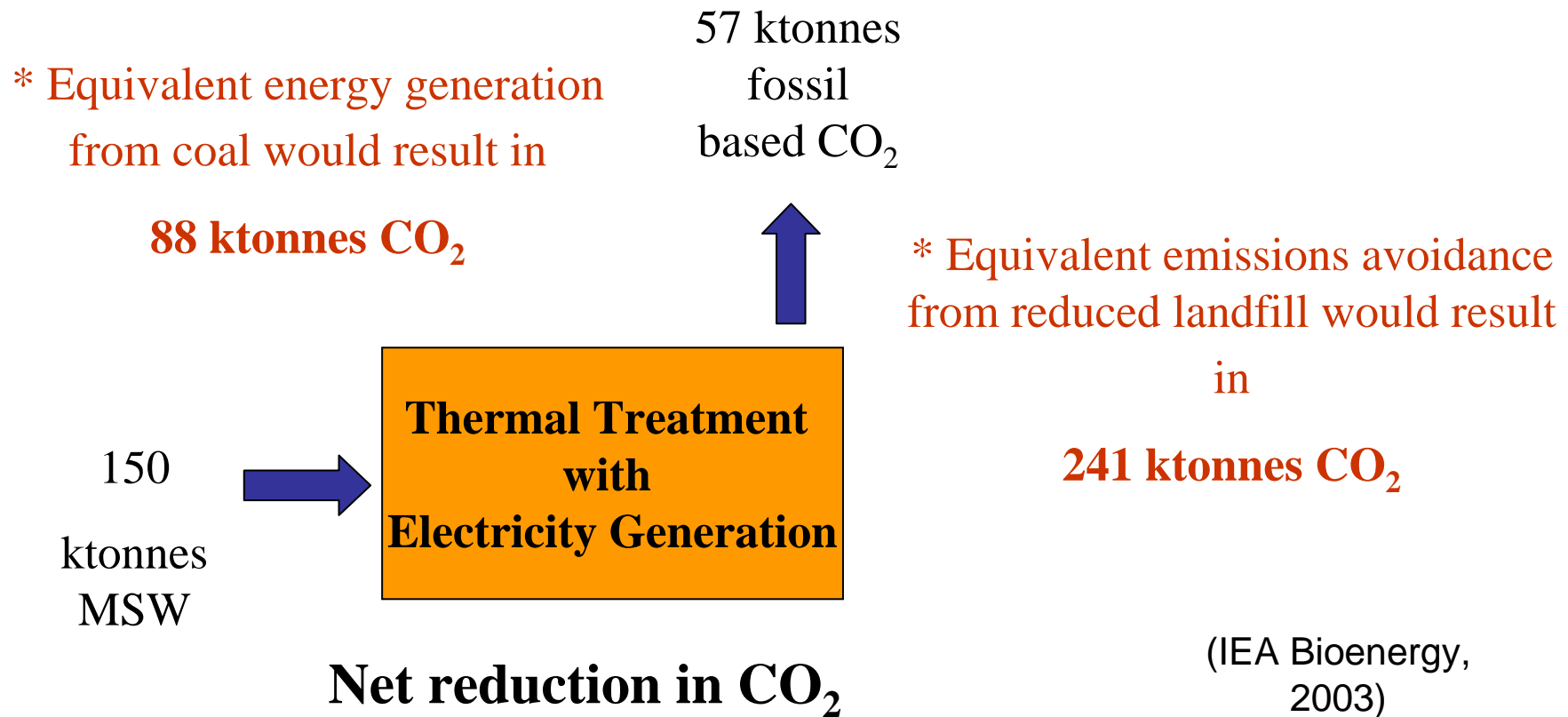
(IEA Bioenergy, 2003)

\* Avoided Emissions related to landfill

70 kg of methane per tonne of MSW equivalent to 1610 g CO<sub>2</sub> per tonne

# Municipal Solid Waste (MSW)

## Thermal Treatment Plant



$$= 57 - 88 - 241 = - 272 \text{ ktonnes}$$

(IEA Bioenergy, 2003)



# **Municipal Solid Waste (MSW)**

## **Thermal Treatment Plant**

**1 tonne** of waste thermally treated  
equivalent to **1.8 tonne** of CO<sub>2</sub> avoided

**0.584 million tonne** equivalent to **1.1  
million tonne** CO<sub>2</sub> avoided

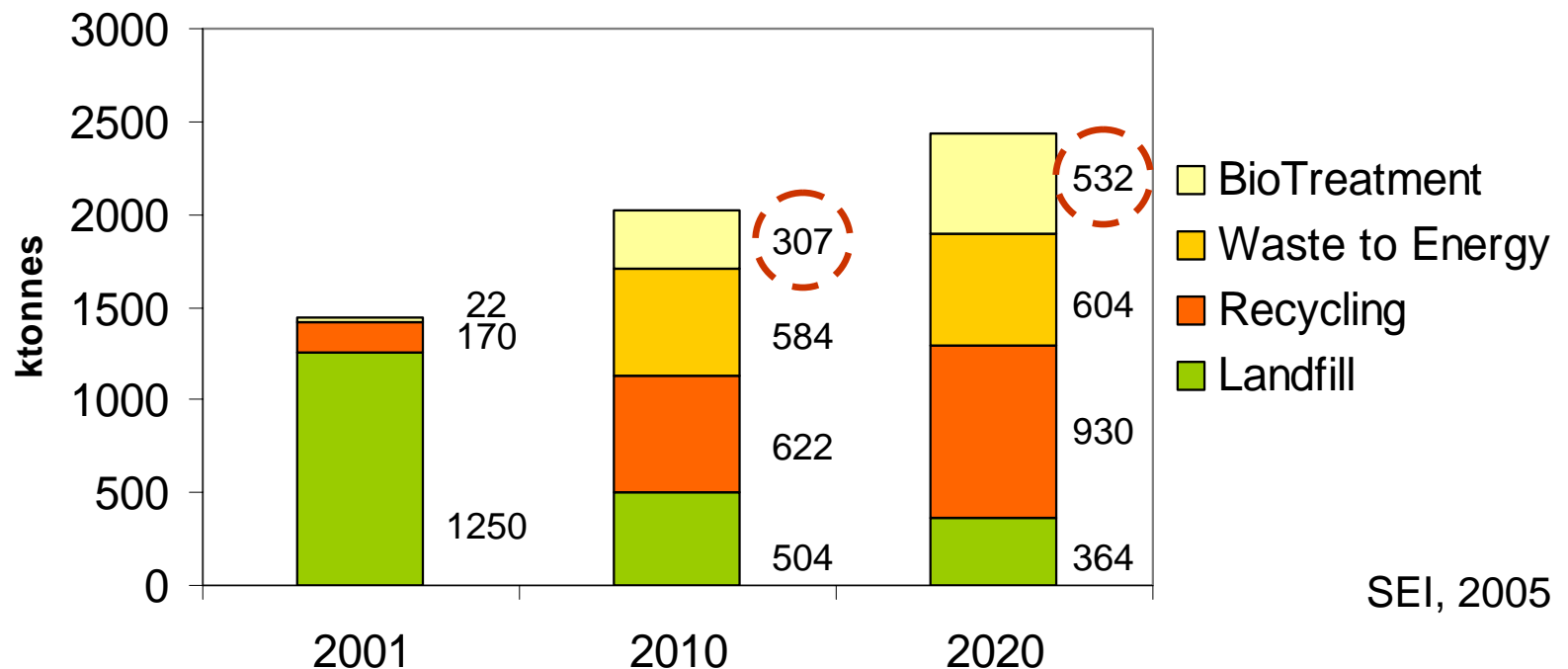
# Municipal Solid Waste (MSW)

## BioTreatment Options

- Anaerobic digestion
  - Biogas, water and compost
- Currently no plants in operation in Ireland
- Estimated generation capacity of 100 – 150 kWh per ton of MSW

# Municipal Solid Waste (MSW)

## Disposal and Recovery Scenarios Paper, Organics and Textiles



SEI, 2005

# Municipal Solid Waste (MSW)

## BioTreatment Options

- Energy requirements could be met for
  - Between 6,700 to 10,000 homes by 2010
  - Increasing to between 11,600 to 17,400 homes by 2020

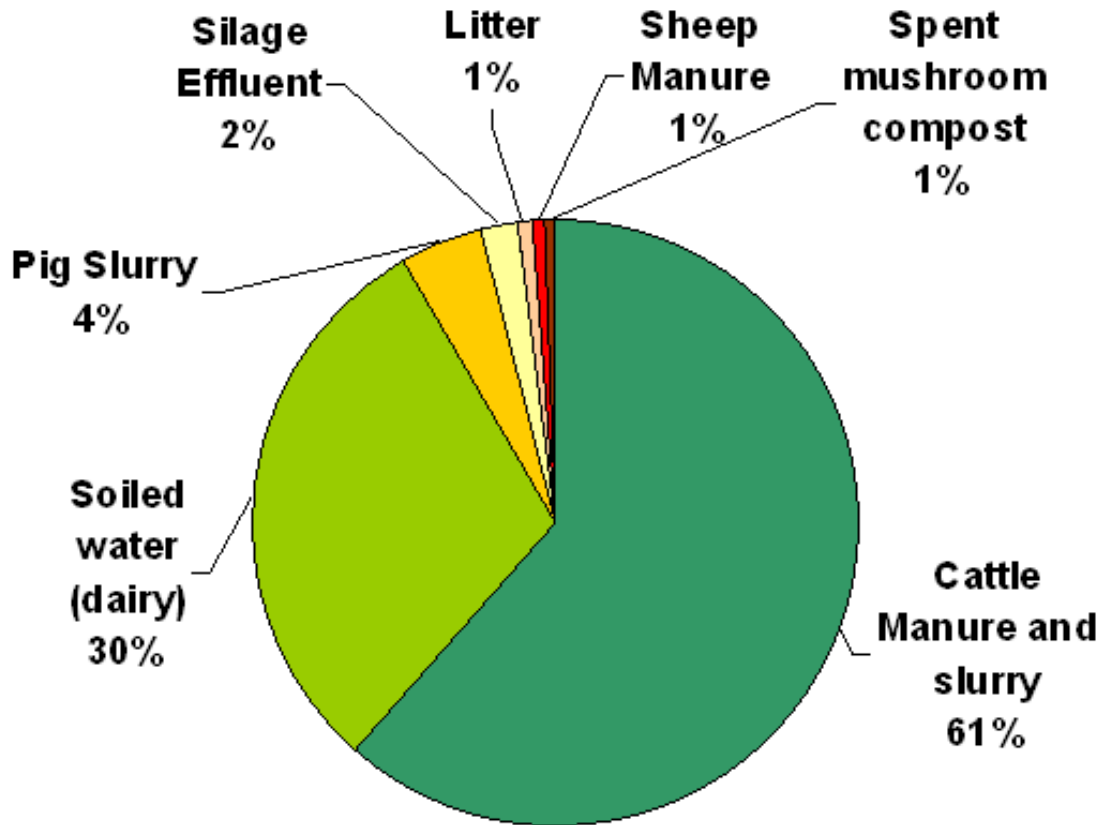
# Municipal Solid Waste (MSW)

## BioTreatment Options

- GHG benefits
  - An average home in Ireland uses about 4600 kWh of electricity per yr ~ 4.5 tCO<sub>2</sub> per yr
  - Potential to offset substantial proportion of between **30-45 ktCO<sub>2</sub>** in 2010
    - + **494 ktCO<sub>2</sub> resulting from landfill avoidance**
  - Increasing to **52.2 – 78.3 ktCO<sub>2</sub>** in 2020
    - + **856 ktCO<sub>2</sub> resulting from landfill avoidance**

# Agricultural Waste Stream

## Composition



**Total of**  
**56 million tonnes**

# Agricultural Waste Stream

## Disposal and Recovery

- Majority is currently managed by spreading on land
  - Soil fertiliser
- Considered recovery if managed in accordance with the farm nutrient management plan

# Agricultural Waste Stream

## Bio Treatment

- Anaerobic digestion
  - Biogas, water and compost
- A few small on farm operations, likely to increase with available price support through AER (IV)



# Agricultural Waste Stream

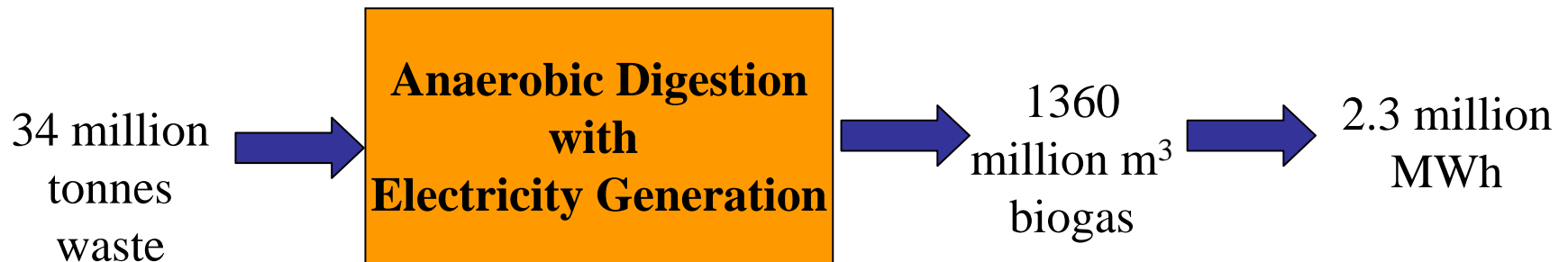
## Bio Treatment

- Approximately 34 million tonnes waste stored and available for anaerobic digestion
- 1 tonne of waste generates 40m<sup>3</sup> of biogas
- 1m<sup>3</sup> biogas generates 1.7 kWh electricity

# Agricultural Waste Stream

## Bio Treatment

\* Equivalent energy generation  
from coal would result in  
**2.27 million tonne CO<sub>2</sub>**



# Potential Contribution of Waste Streams

	Energy Generation (million MWh)	Emissions Avoidance (million tonne CO <sub>2</sub> equivalents)
Thermal Treatment MSW	0.3	1.1
Bio Treatment MSW	0.3	0.5
Bio Treatment Agriculture	0.3	0.5
<b>Total</b>	<b>2.9</b>	<b>3.9</b>

12% of total  
electricity  
generation

6% of total  
GHG  
emissions

# Conclusions

- **Potential**
  - 12% of the current electricity demand could be met by waste biomass
  - Annual GHG emissions reductions potential is high but lifecycle analysis required to provide a more accurate picture
- **Drivers for change**
  - Policy and associated support programmes
  - Potential of guaranteed indigenous fuel

# Thank You



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