Ricardo
Energy & Environment

Part 2: Environmental impacts

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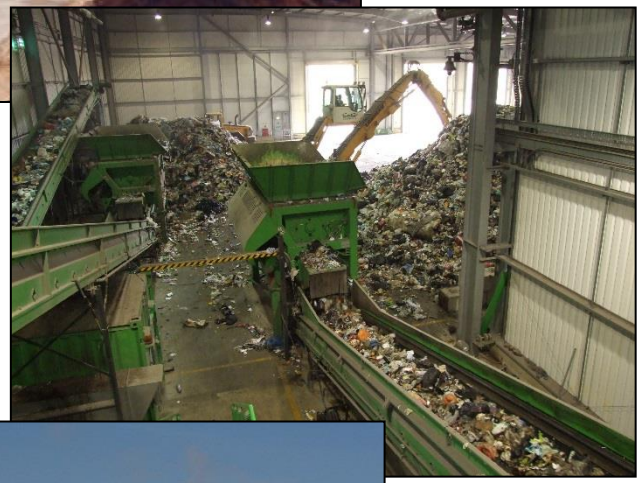
Waste Treatment – Recap of Approaches



Emissions to the Environment

- **Point source**
  - Single, identifiable, localised, easily measured
  - To air, water or land
  - Incinerator stack, gas engine exhaust, biofilter stack
  - Point of consented discharge to water
- **Fugitive**
  - Diffuse, generated as part of operation of the facility
  - To air, water or land
  - Uncontrolled landfill gas emissions
  - Noise, dust, odour and litter from treatment sites

Source: Omega Energy

An Environmental Permit is required to operate a waste facility in the EU

- ➢ Limits emissions to acceptable level for the local context
- ➢ Continuous improvement driven by European Regulations

Too big, too risky and in wrong place

ban the burn!

Environmental Issues for Waste Treatment Technologies

- WtE and supporting technologies have potential impacts – that can be controlled

Activity	Noise	Odour	Dust	Flora/ fauna	Soils	Water quality/flow	Air quality	Climate	Building damage
MRF	×	×	×	×	×	××	××	-	-
Composting	××	×××	××	✓	× ✓	××	×××	×	-
MBT	××	×××	××	-	-	××	××	×	×
Anaerobic digestion	××	××	×	× ✓	× ✓	××	××	×	×
Gasification/ pyrolysis	××	××	××	-	-	-	××	×	×
Incineration with pre-sorting	××	××	×××	××	××	××	×××	×	×
Incineration	××	××	×××	×××	×××	×××	×××	×	×
Landfill	×××	×××	××	××× ✓	×××	×××	×××	××××	×
Waste transfer stations	××	×××	×	-	-	××	×	✓	-

✓	Direct or indirect benefit	××	Potentially significant impact in some cases, but can be controlled
-	No effect	×××	Impact is normally controlled, but an issue at sites where design, engineering or operation falls below best practice
×	Unlikely to be significant	××××	An issue at all sites

Controlling the Impacts

- EC reference documents on best available techniques (BAT) “BREFs”
- Main reference documents for European competent authorities issuing permits for installations
- 10 years old – a long time for waste BAT
- Backed up by specific technical requirements for WtE in European regulations
- Swathe of other regulations and guidance
- Effective enforcement is critical

Life Cycle Thinking

- Appropriate to consider life cycle environmental impacts (+ or -)
  - Quantify and compare the relative environmental burdens of equivalent integrated waste management systems across their entire life cycle
- Common to compare systems using Global Warming Potential (GWP)
  - Most widely understood impact
  - GWP over 100 years used in Kyoto Protocol
  - Assess greenhouse gas (GHG) emissions / avoided emissions ('offset')
  - Reported in tonnes of CO_2 equivalent emissions (+ or -)

Source: Penn Energy

Carbon in mixed waste includes both:

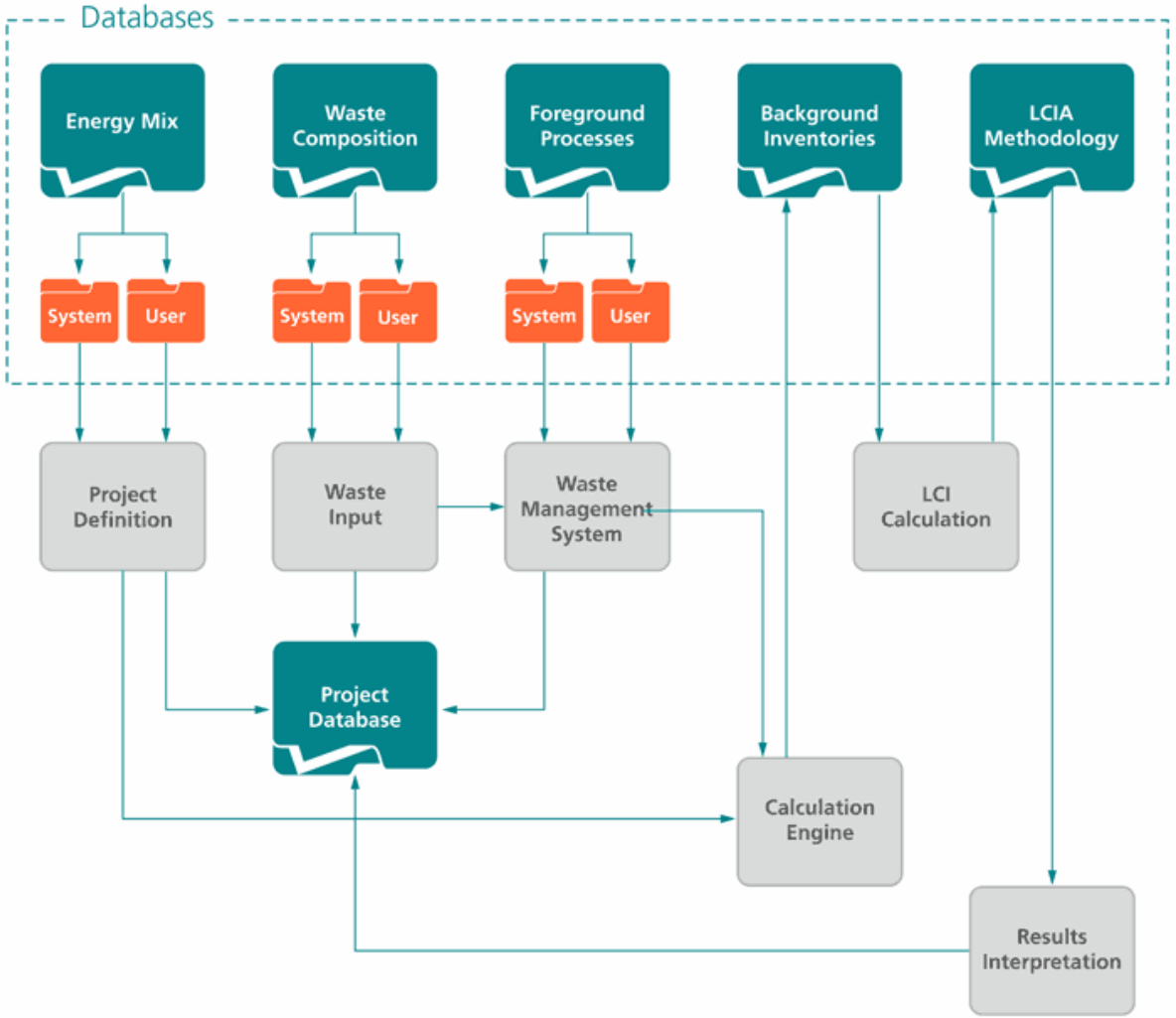
- Biogenic 'short-cycle' (e.g. food, wood) and
- Non-biogenic 'fossil' (e.g. plastics)

IPCC (*Intergovernmental Panel on Climate Change*) Guidance:

- Only account for fossil CO_2 emissions
- Net addition to atmospheric CO_2

- There are other impact categories e.g.:
  - Resource depletion potential (extraction / avoided use of minerals & fossil fuels)
  - Human toxicity potential

Measuring Comparable Environmental Impacts

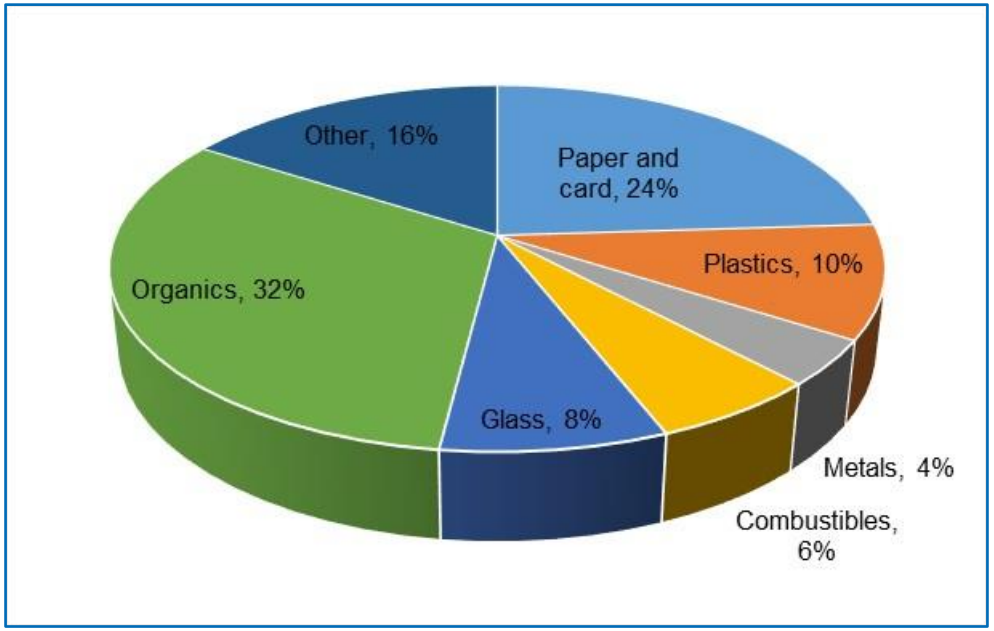


- UK Government life cycle assessment (LCA) model for waste systems
- 'WRATE' *Waste and Resources Assessment Tool for the Environment*
- Assess environmental impacts of waste management activities over their whole life
  - 'Gate' (discarded) to
  - 'Grave' (managed)
- Calculate impacts of all processes
  - Collection to final disposal
  - Construction and operation
- Offset against avoided burdens
  - Material and energy recovery

Source; http://www.wrate.co.uk/

WRATE LCA Example

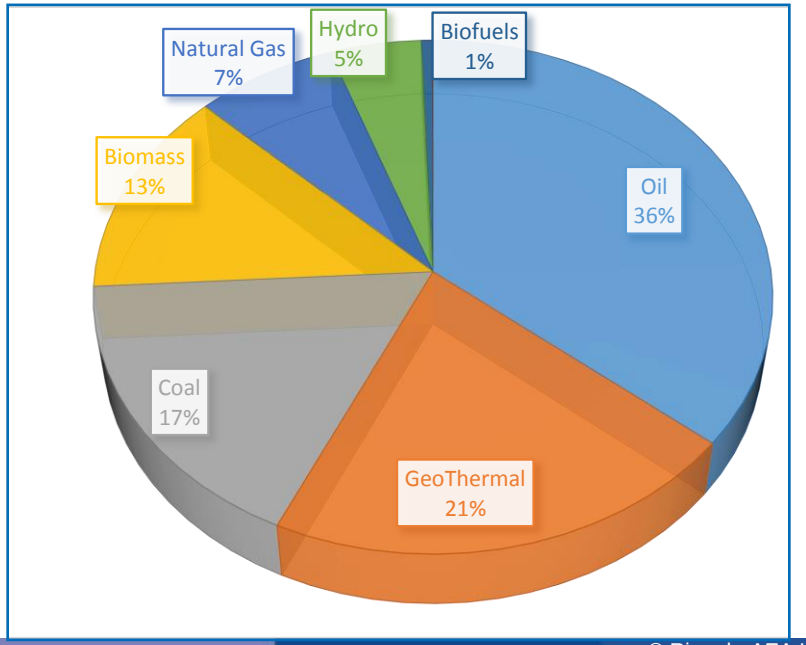
- 200,000 tonnes per year MSW



- Waste Composition (%)

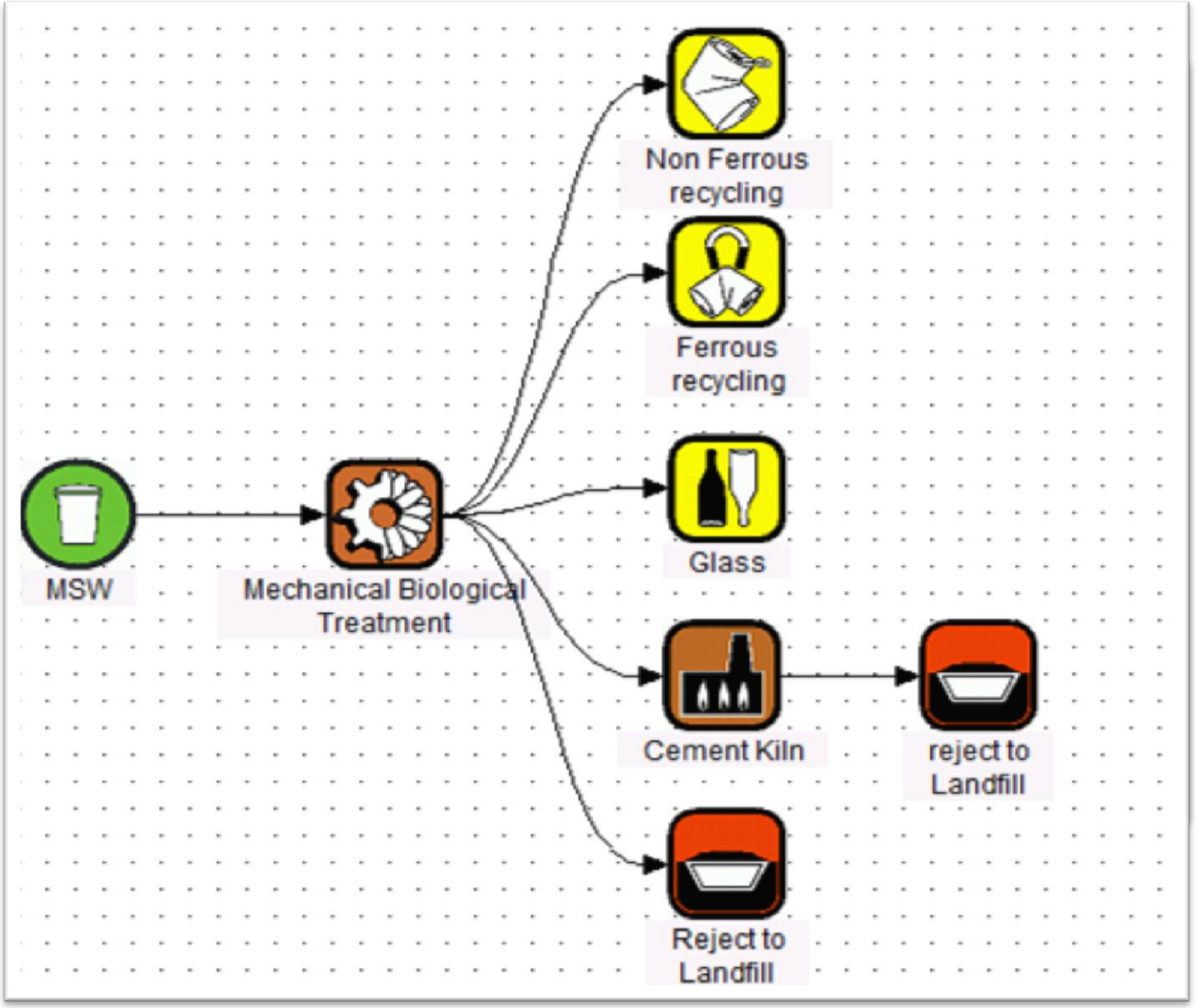
Paper and card	24
Plastics	10
Metals	4
Combustibles	6
Glass	8
Organics	32
Other	16

- Electricity offset
  - Philippines Primary Energy Supply Mix
  - Represents ‘avoided energy use’

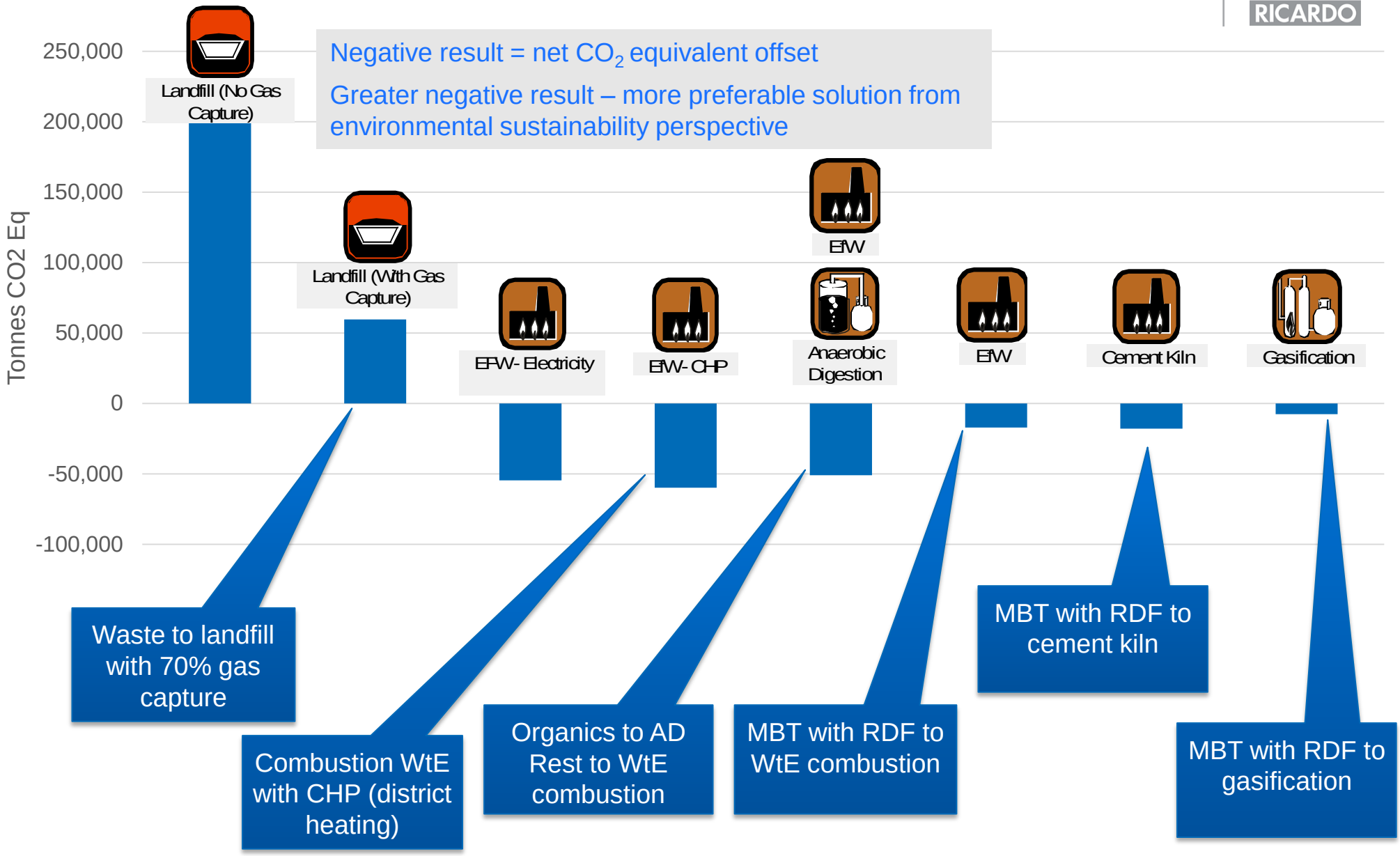


Source: http://www.doe.gov.ph/policy-planning/key-energy-statistics-2010/1154-energy-mix

Example Scenarios



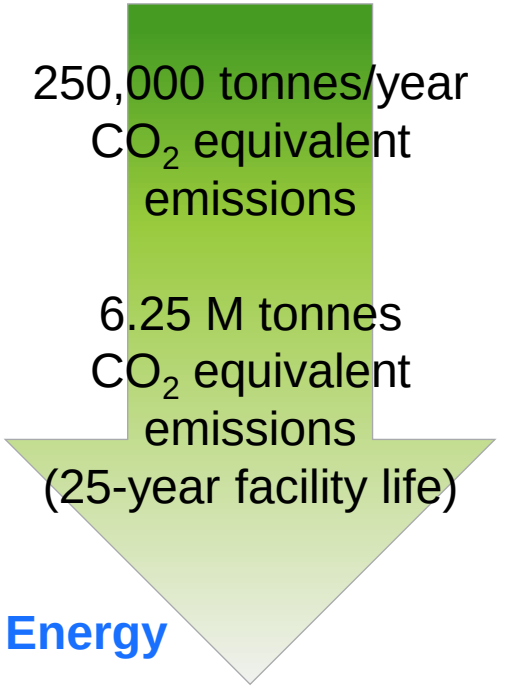
GWP Results – Global Warming Impact



GWP Results Discussion

- Simplistic assessment indicates:
  - Landfill gas utilisation gives significant benefit
  - WtE solutions significantly reduce life cycle CO_2 equivalent emissions
    - Energy recovery offsets use of fossil fuels
    - Recycling can give significant further gains

- Results are potentially conservative
  - 'Default' processes not pushing energy efficiency
  - Relatively low fossil generation in assumed energy mix
    - Higher baseline fossil fuel – higher avoided CO_2
  - Relatively low recycling (e.g. plastics, aluminium)



- **Environmental sustainability opportunity**
- **Triple win: Waste Treatment – Climate Change – Renewable Energy**