Comparing the Environmental Impacts of Residual Waste Management Options

Judith Bates (AEA)
IEA Task 36

IEA Bioenergy Multi-task Conference, August 2009, Vancouver

Background

- IEA Task 36 wanted to examine environmental impacts of treatment options for residual waste
- Used an integrated waste management life cycle tool WRATE
- Representative set of treatment options, common elements (e.g. collection) excluded
- Looked at impact of higher energy and material recovery rates and of electricity mixes

Waste Management Options Examined

- Energy from Waste plant exporting electricity
- Energy from Waste plant exporting heat and power
- Mechanical Biological Treatment plant where recyclable materials such as metals are first separated out and the remaining waste is
    - biodried to produce a refuse derived fuels which is burnt in an energy from waste plant
    - sorted into an organic component which is anaerobically digested and a fraction which is burnt in an energy from waste plant
    - sorted into an organic component which is composted and a fraction which is burnt in an energy from waste plant

Key characteristics

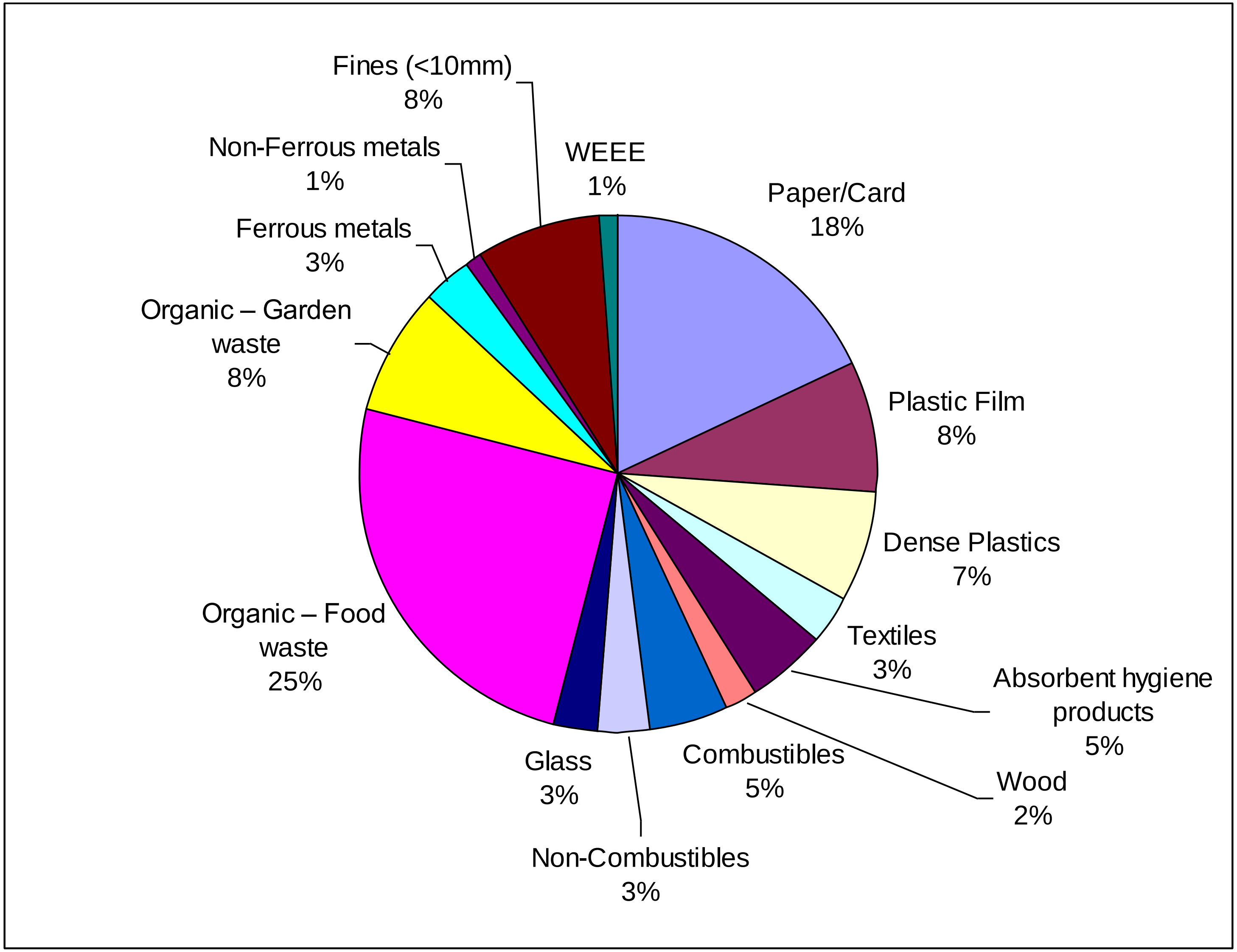
Key characteristics for EFW plant

	Typical efficiency	**High efficiency**
Power only	23.40%	25%
	21% elec	20% elec
	22% heat	70% heat
	Typical recovery	**Higher recovery**
Ferrous metal recovery rate	80%	80%
Non-ferrous recovery rate	35%	50%

Key characteristics for MBT plant

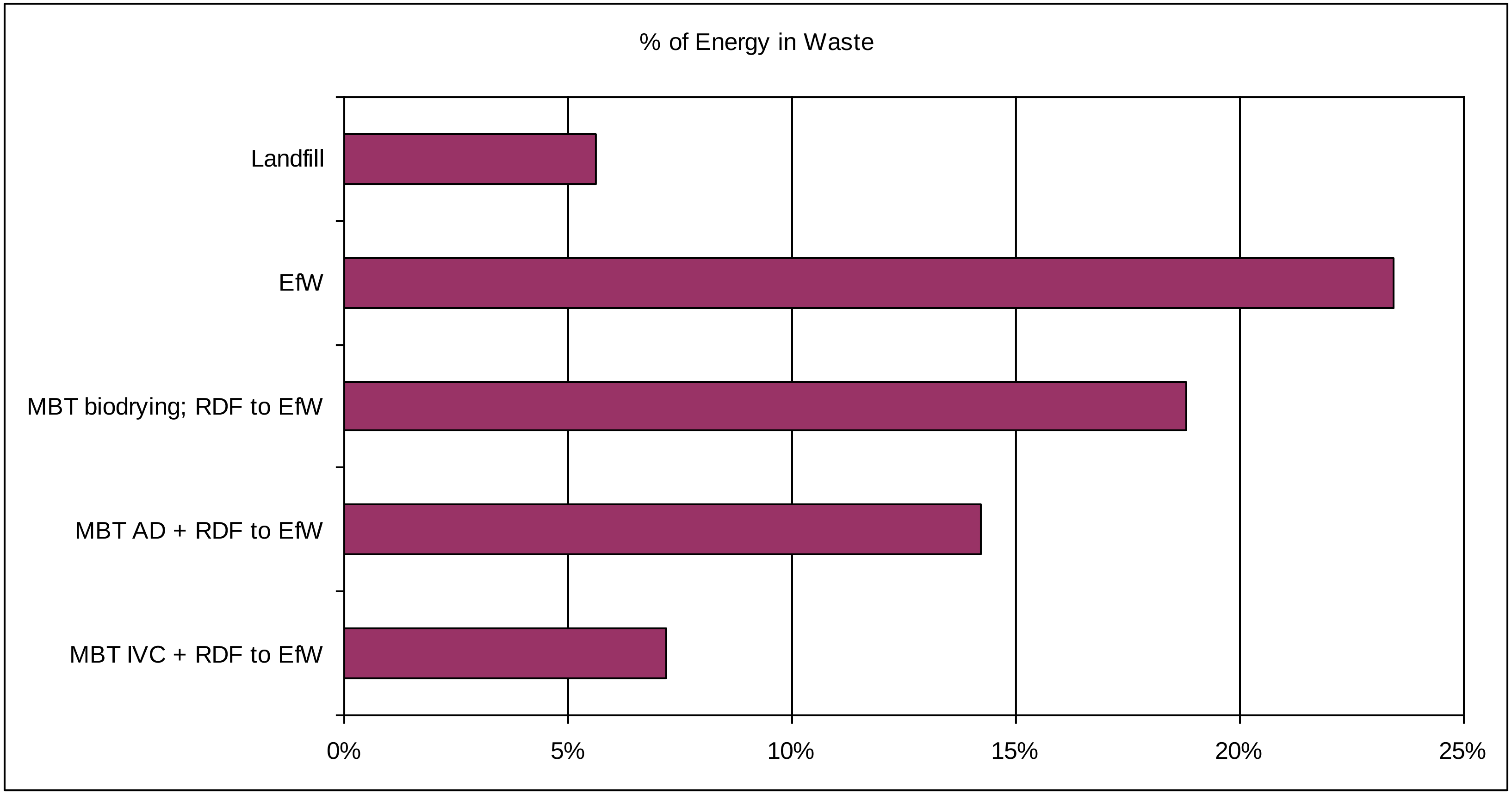
	Typical Recovery rate	**Higher Recovery rate**
Ferrous metal recovery rate	82%	
Non-ferrous recovery rate	86%	
Plastics recovery rate		50%

Composition of Residual Waste

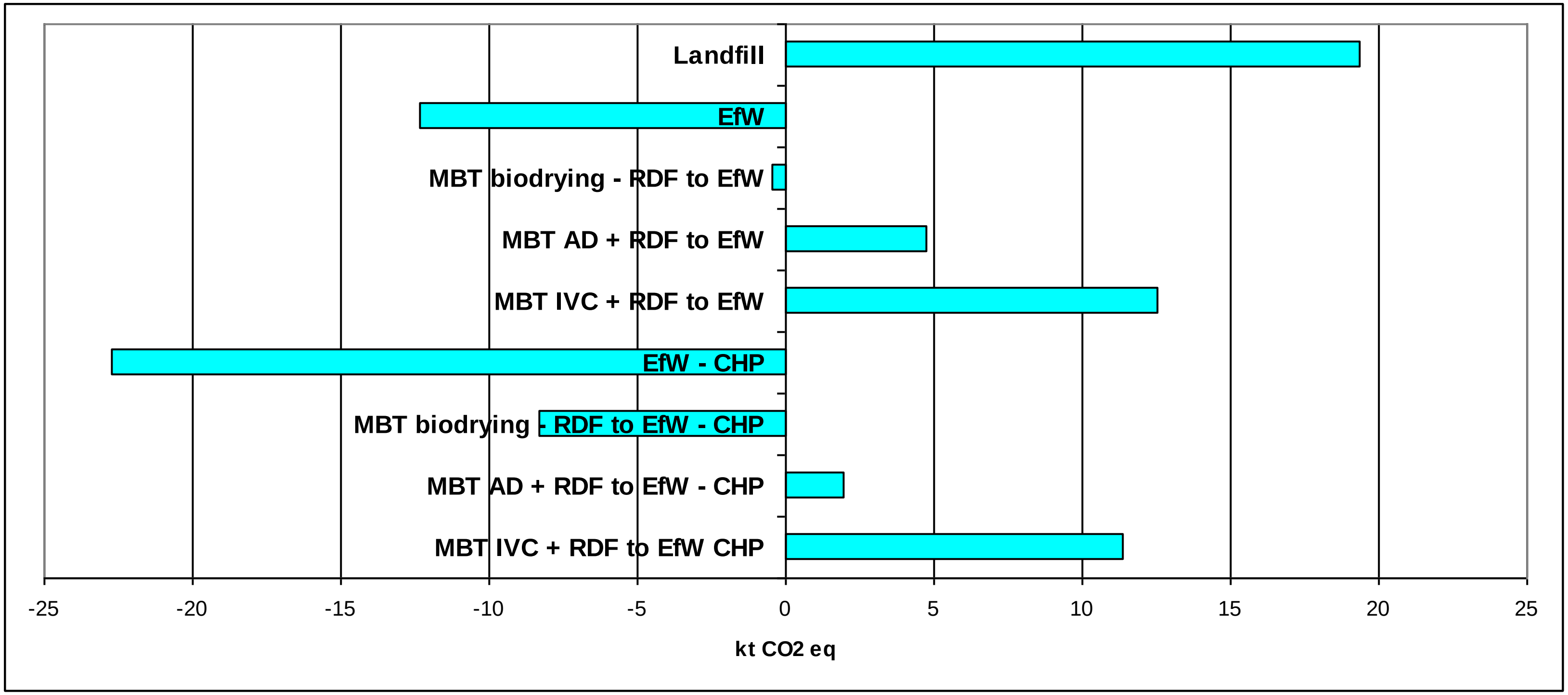


NCV :
8.8 MJ/kg

Energy recovered

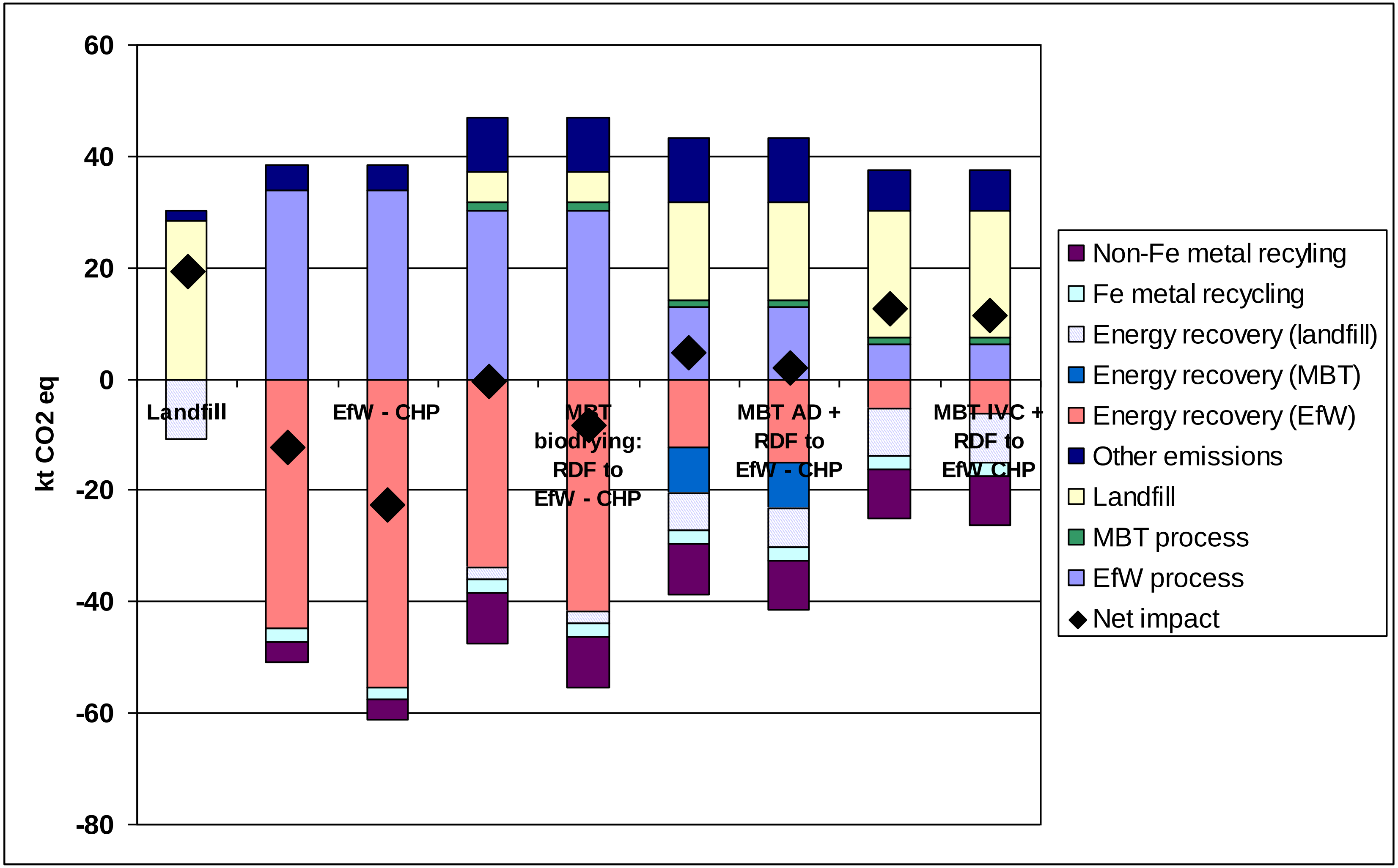


Climate Change Impacts

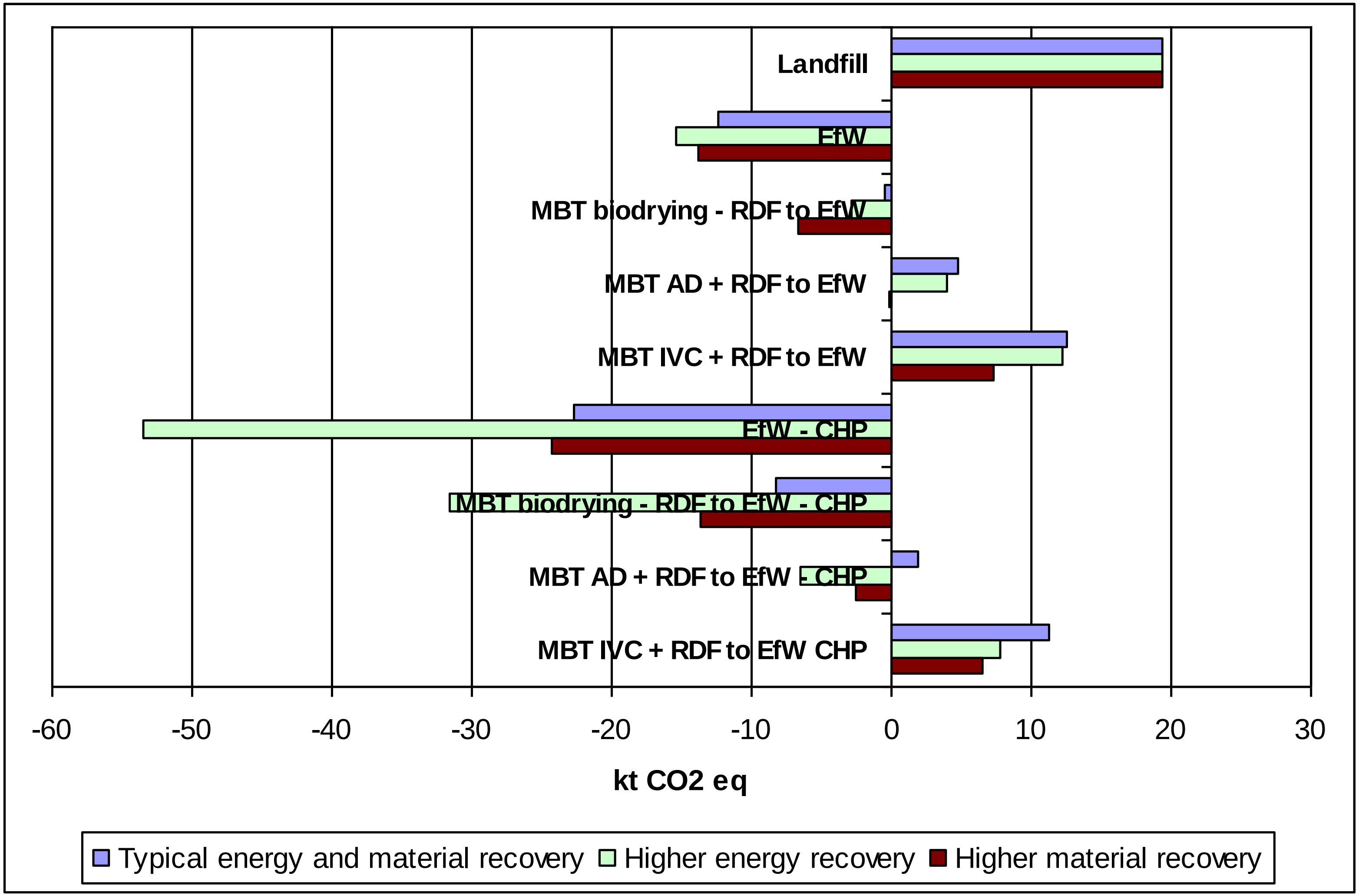


- All options better than landfill
- EfW better MBT options (because of greater energy recovered)
- Use of CHP improves all options

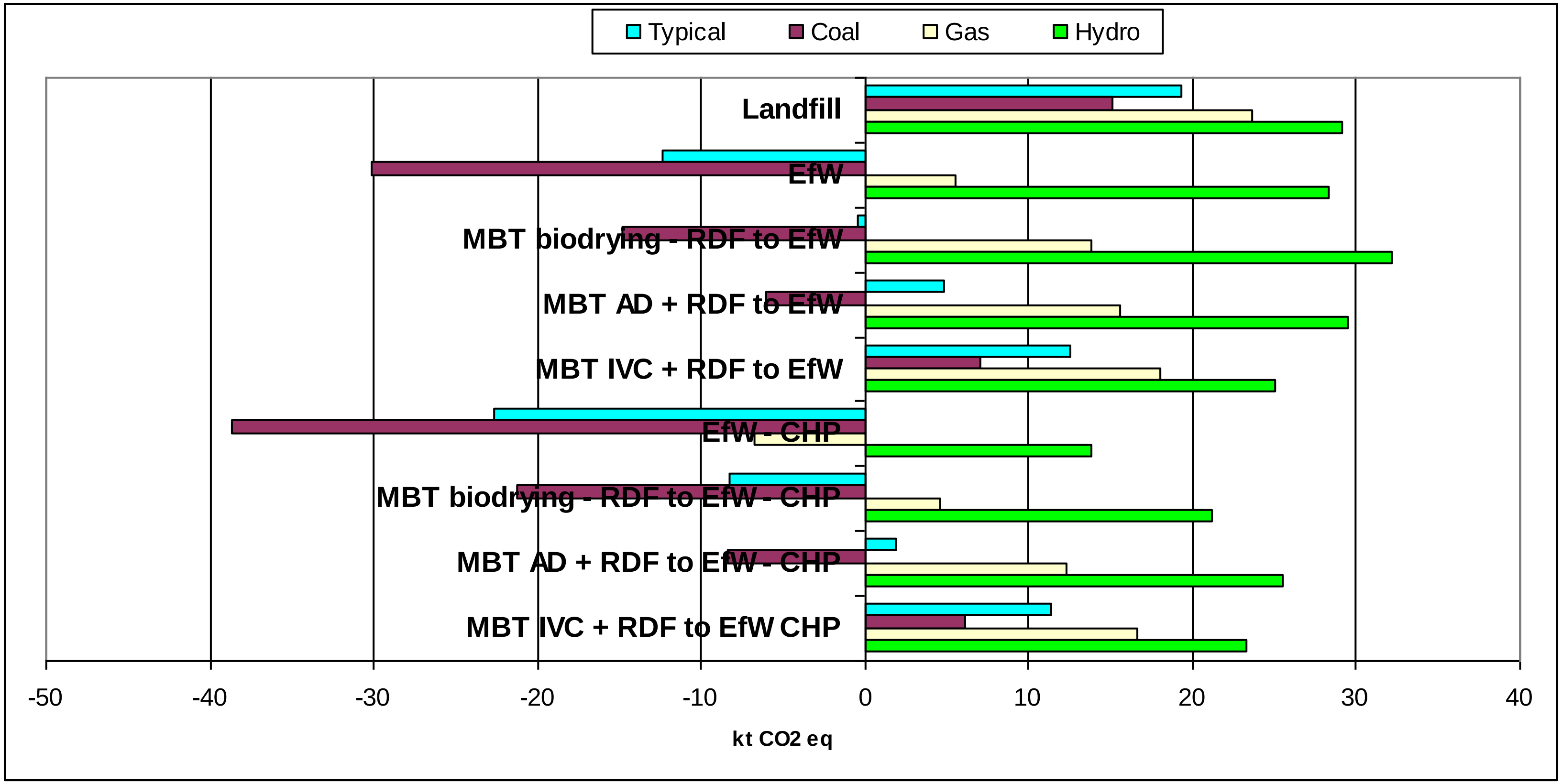
Breakdown of climate change impacts



Impact of improved efficiency and material recovery

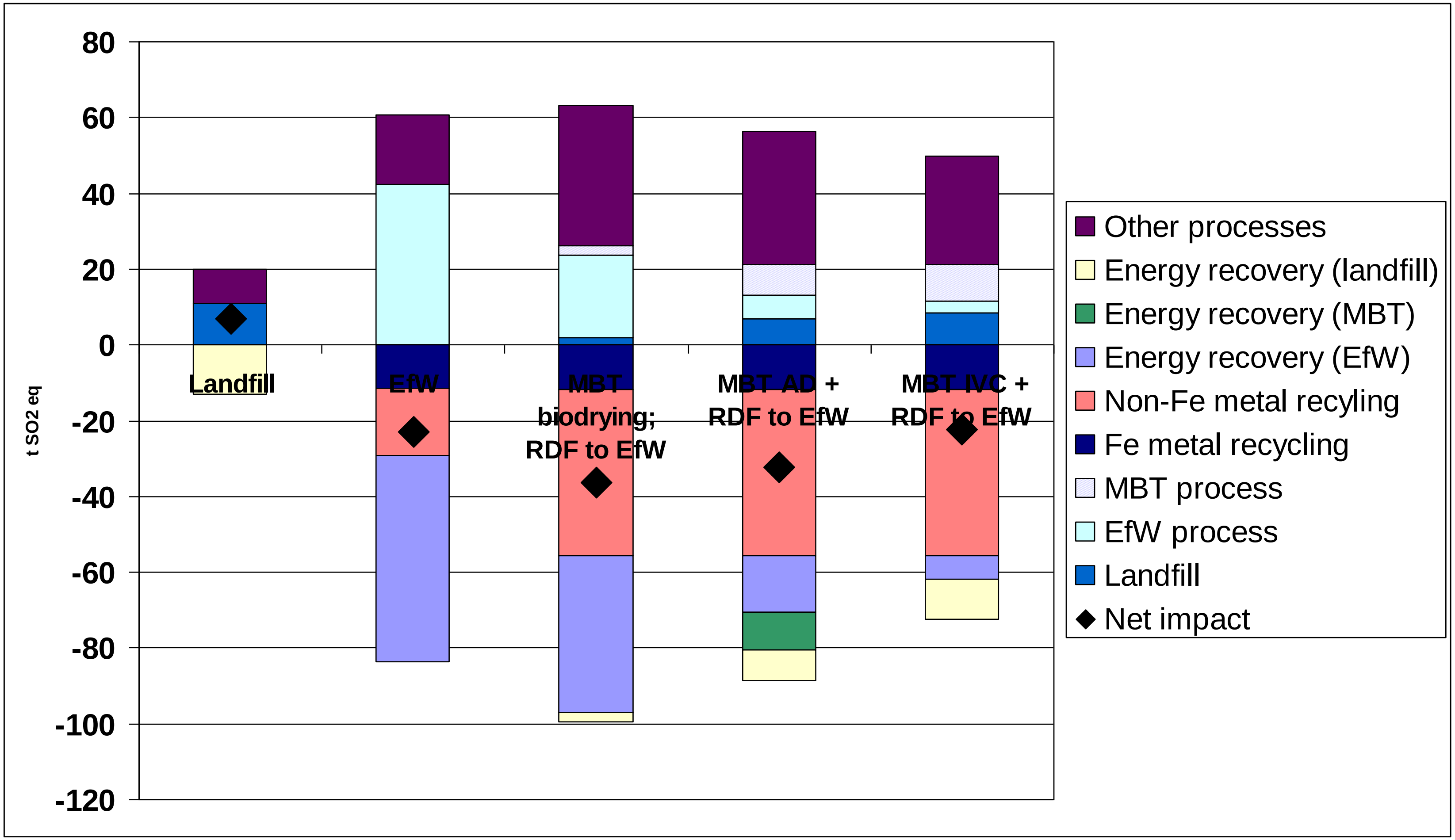


Sensitivity to electricity mix

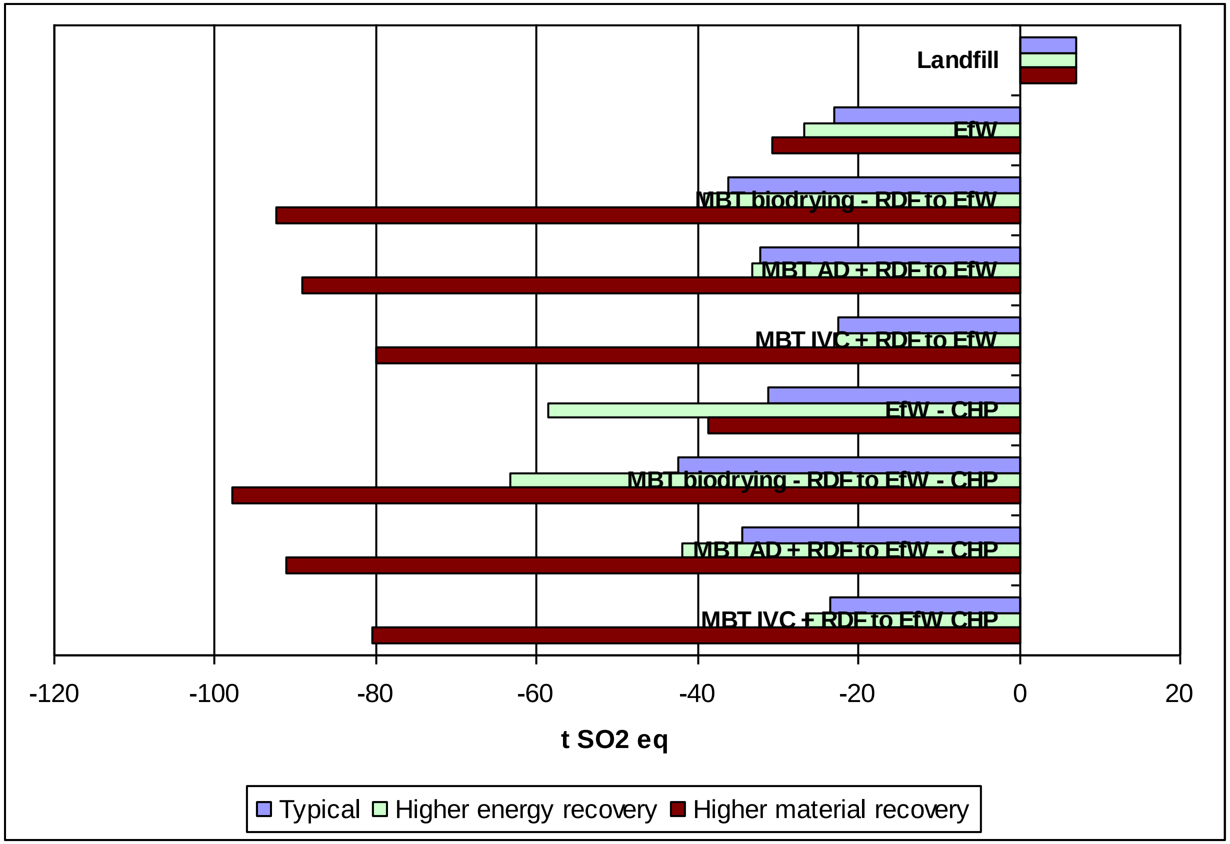


When low carbon electricity is displaced (e.g. hydro), benefits of EfW are reduced, unless it is CHP,when it is still ‘preferred’ option

Acidification

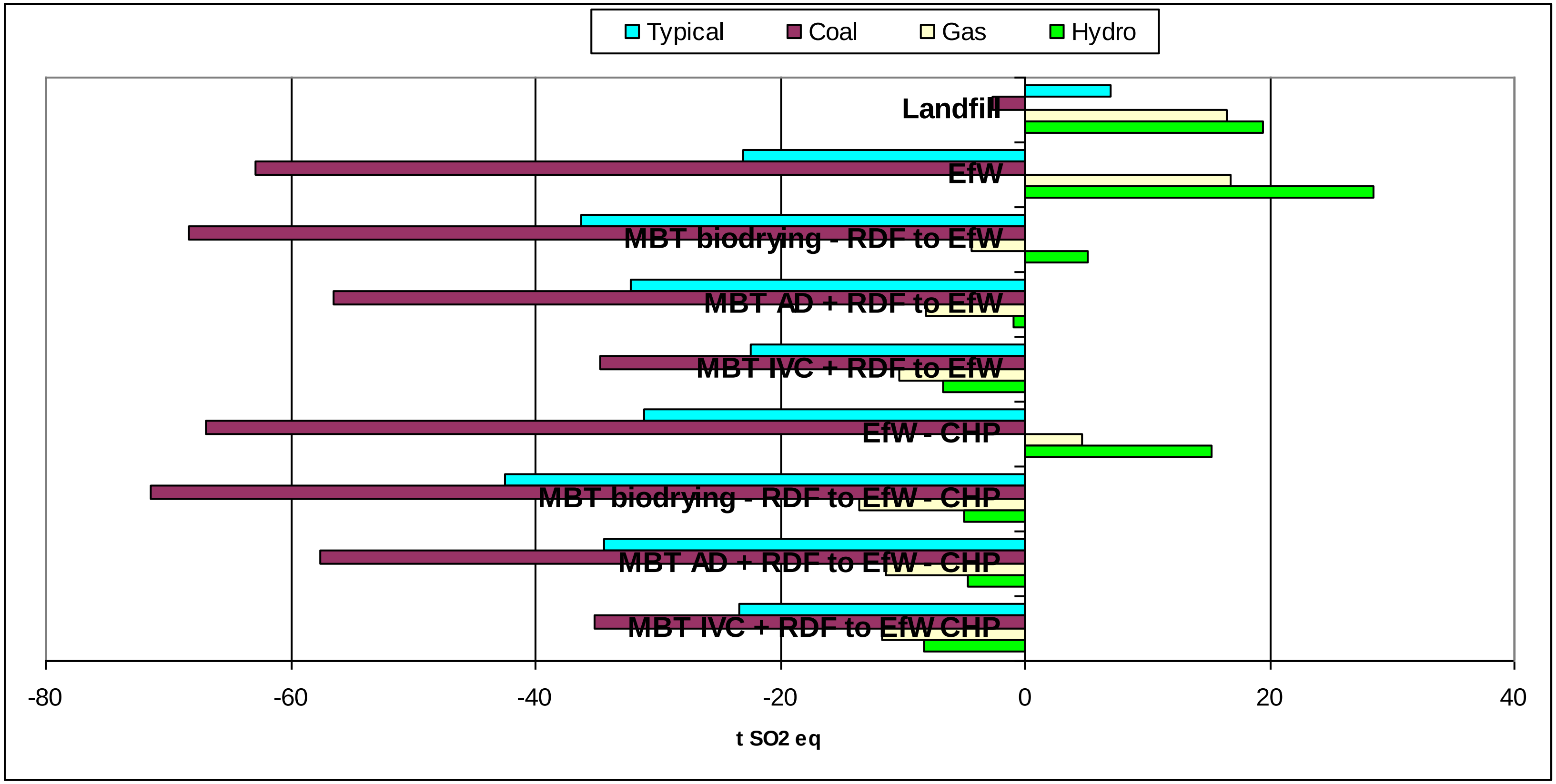


Acidification – extra energy and materials recovery



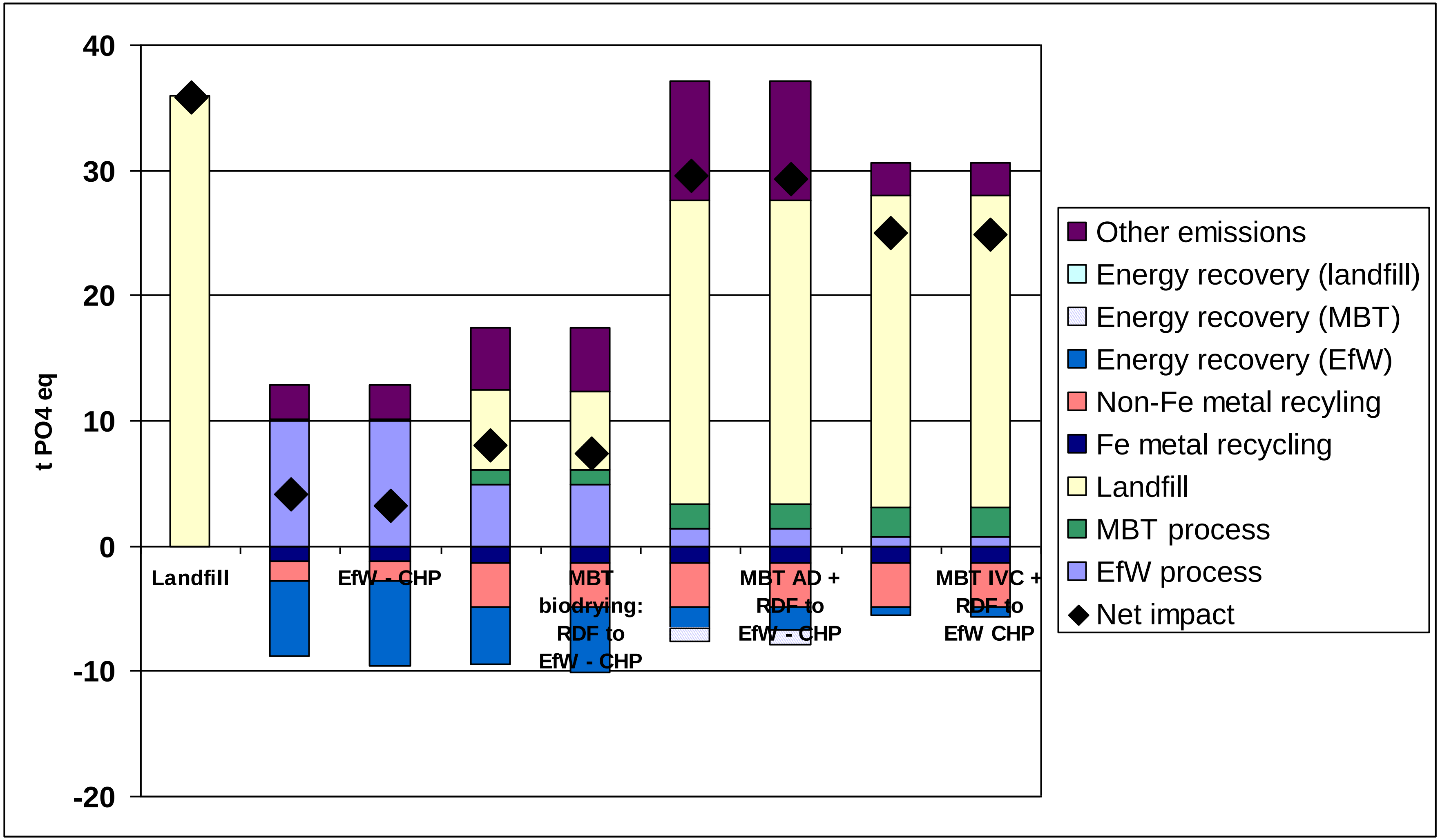
Recovering plastics at MBT offers very large reduction in acidification benefits

Acidification and electricity mix

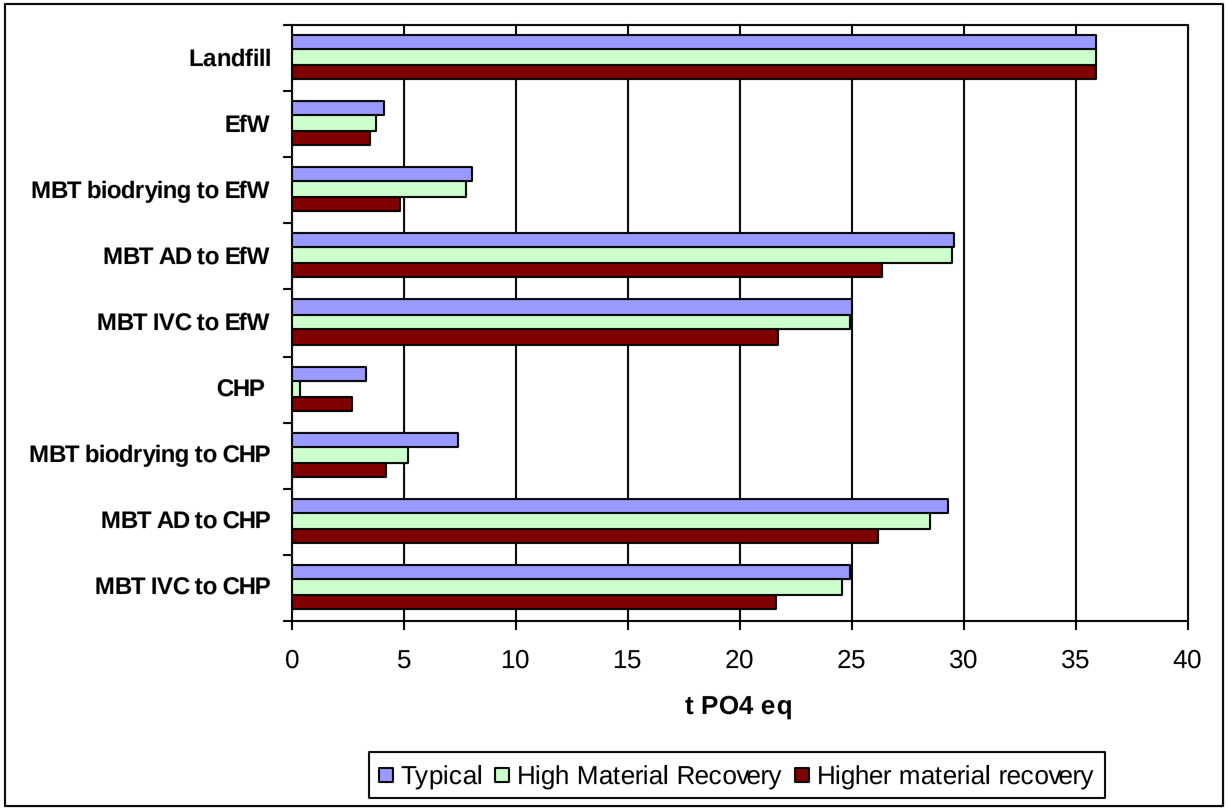


With ‘cleaner’ electricity mixes, EfW performs has worse acidification impact than other options

Eutrophication

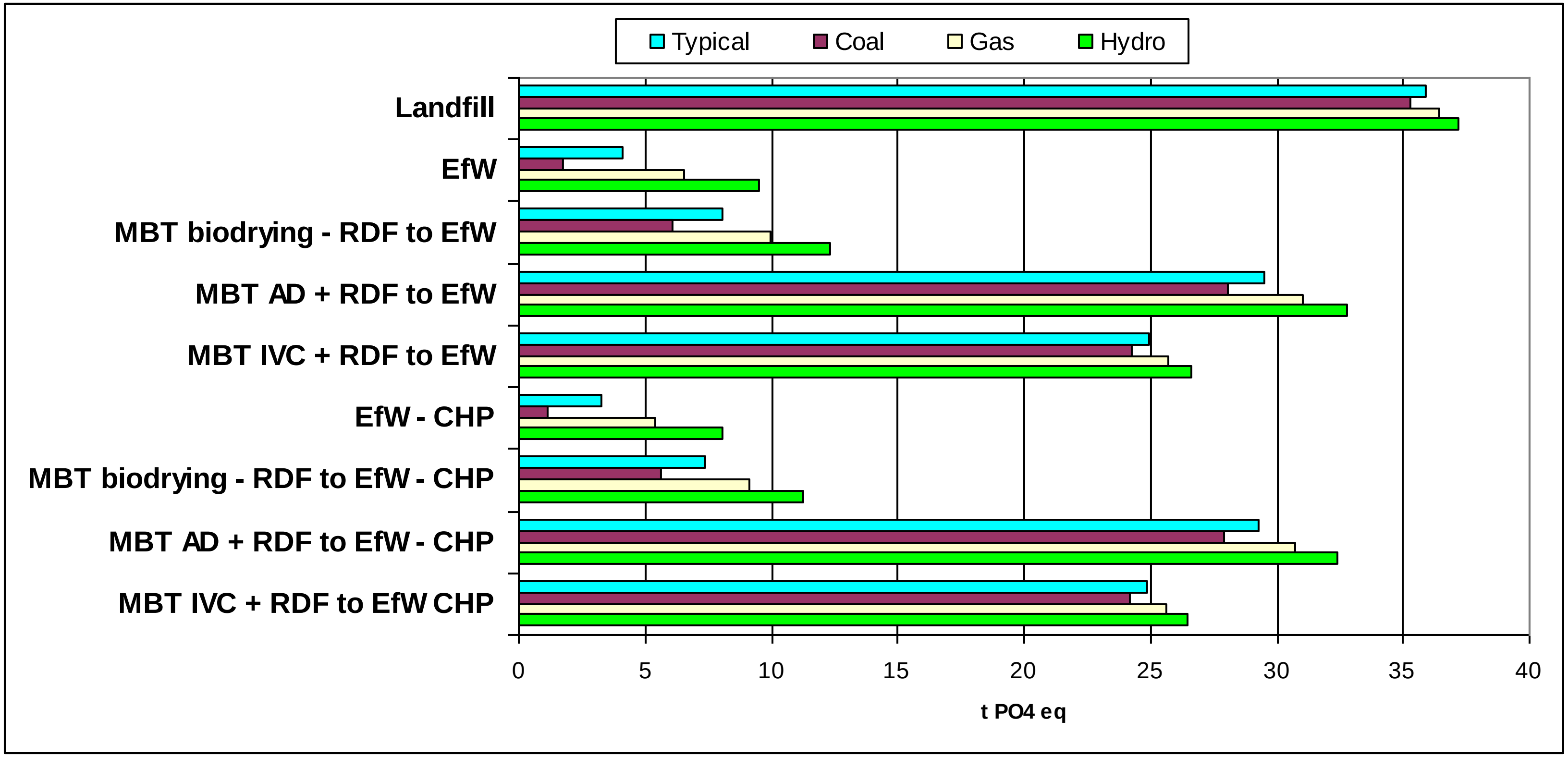


Eutrophication – extra energy and materials recovery



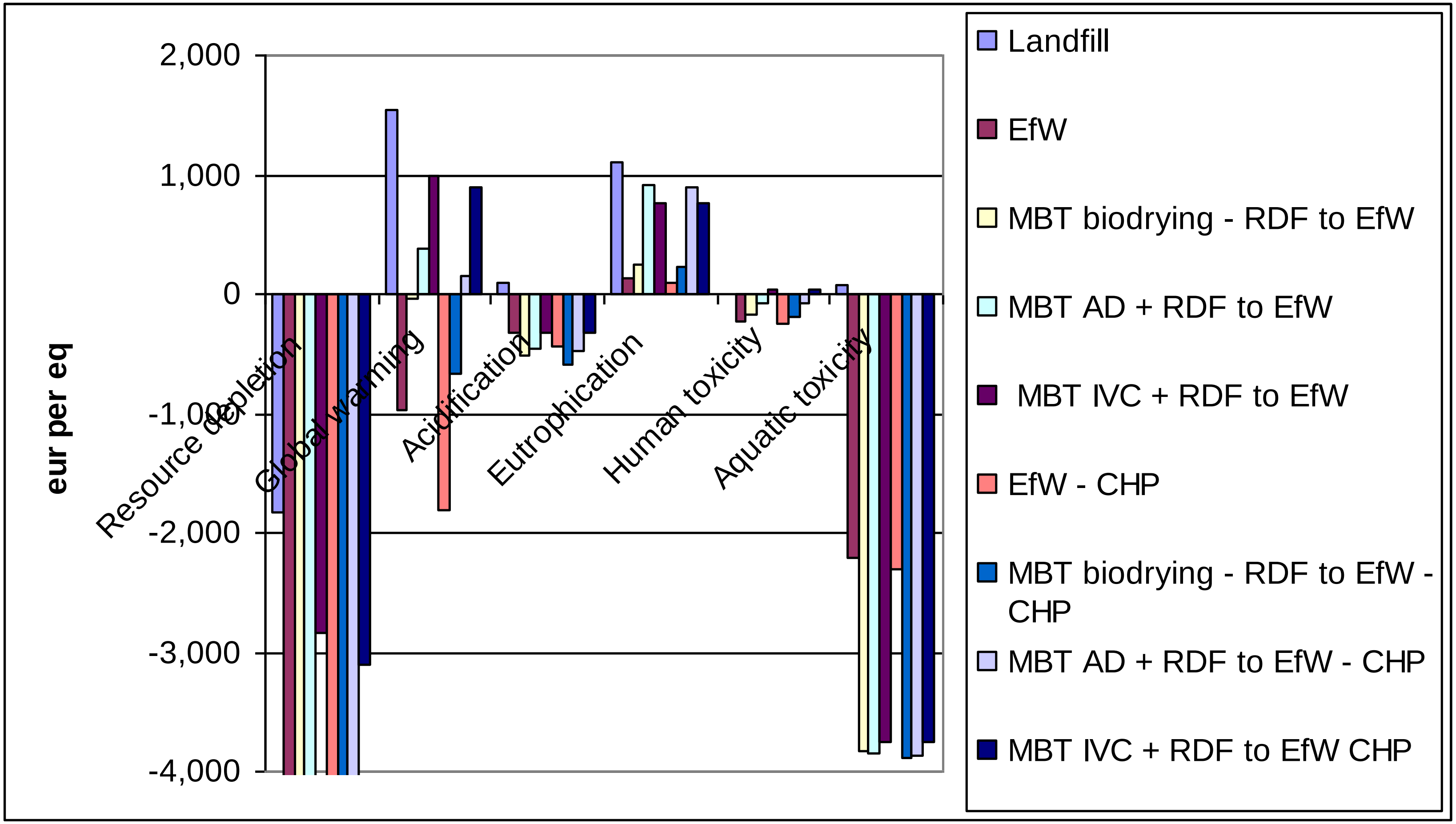
As landfilling contributes significantly to impact, extra energy and materials recovery make relatively little difference

Eutrophication and electricity mix



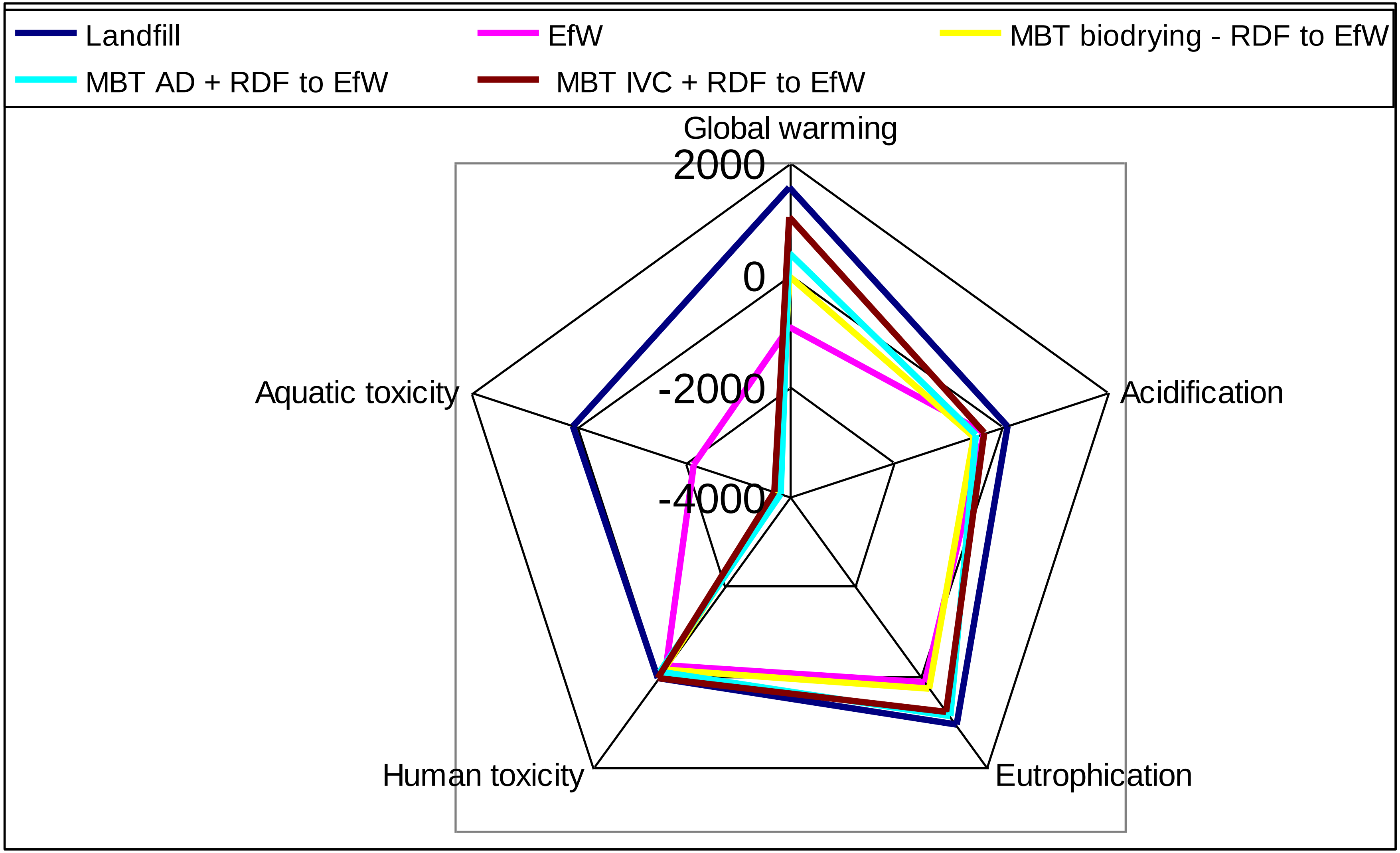
EfW has least impact regardless of electricity mix

How important are other impacts



Resource depletion and aquatic toxicity also important

How do options compare (electricity only EfW)



Conclusions

- No unique hierarchy: depends on
  - electricity mix
  - level of materials and energy recovery
  - ‘ranking’ of environmental impacts
- If reducing global warming is of key importance then:
  - EfW offers significant benefits if coal or coal/gas is displaced
  - If can utilise heat and have EfW – CHP plant then there are also benefits even if electricity mix is gas based
  - Where electricity from the EfW plant would displace a very low carbon electricity mix, other MBT technologies where less waste is combusted may have a lower net climate change impact.