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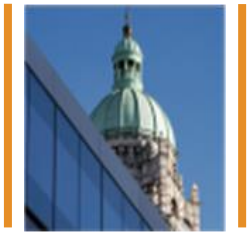
A New Approach to Funding Accelerated Landfill Aftercare

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Independent Consultant & Imperial College London

November 2014

Background


on writing a book.com, 2014

- **Beaven, R., Knox, K., Gronow, J., Hjelmar, O., Greedy, D. & Scharff, H.** (2014) A new economic instrument for financing accelerated landfill aftercare. *Waste Management, 34 (7) 1191-1198.*

- **Liu, Y.** (2014) Market-based Instruments for Promoting Sustainable Landfill Aftercare. MSc dissertation, Imperial College, London. (CIWM/Defra funded) *Available upon request.*

Sustainable Landfilling (IWM,1999)

- The LF must be managed so that outputs are released in a controlled & acceptable way;
- The residues left in the site should not pose an unacceptable risk to the environment;
- The need for aftercare should not be passed on to the next generation;

Caulmert, 2014

- The future use of groundwater & other resources should not be compromised.

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If new LFs are to leave no unacceptable legacy:

- they should be located in least vulnerable positions:
  - we know how to do this;
- we should set WAC that are closer to Equilibrium Status:
  - WACs are under review, although not necessarily for the right reason?;
- we should require accelerated stabilization at sites in order to achieve a sensible site aftercare period.

Financial Provisions

- Aftercare periods are insufficient because:
  - waste degradation is slow;
  - the flushing of potential pollutants from landfill leachate is poor.
- So LF aftercare extends far beyond the ~30 - 60 years often quoted;
  - exacerbated by the tendency of the requirements of the LFD to favour dry entombment measures.

CIWM, 2013

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Sustainability Implications

Based on a goal of achieving FSQ, the most optimistic expectation for the true duration of aftercare under the status quo of landfill design and operational methods is:

- gas management will be required for several **decades**;
- leachate management will be needed for **a century or more.**

- **1986 Swiss policy:** materials should only be landfilled if they could reach FSQ within one generation, defined as 30 years.

- **Denmark** opted not to fully adopt low permeability top covers, for reasons of sustainability.

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Accelerated Stabilization Techniques

1. Few monitored full scale examples of *landfill flushing* to anywhere near FSQ exist.

   It is estimated that ~3-5 m^3 water/t waste is required to achieve the necessary 2-3 orders of magnitude dilution for NH_4-N etc. to reach FSQ.

2. The only method that appears able to achieve any improvement in the tail of the gas curve is *in situ aeration*.

3. It remains to be demonstrated by long-term full scale studies at what LFG emission rates *methane oxidation* can offer effective passive treatment that would allow a LF to be classed as being at FSQ for gas without further intervention.

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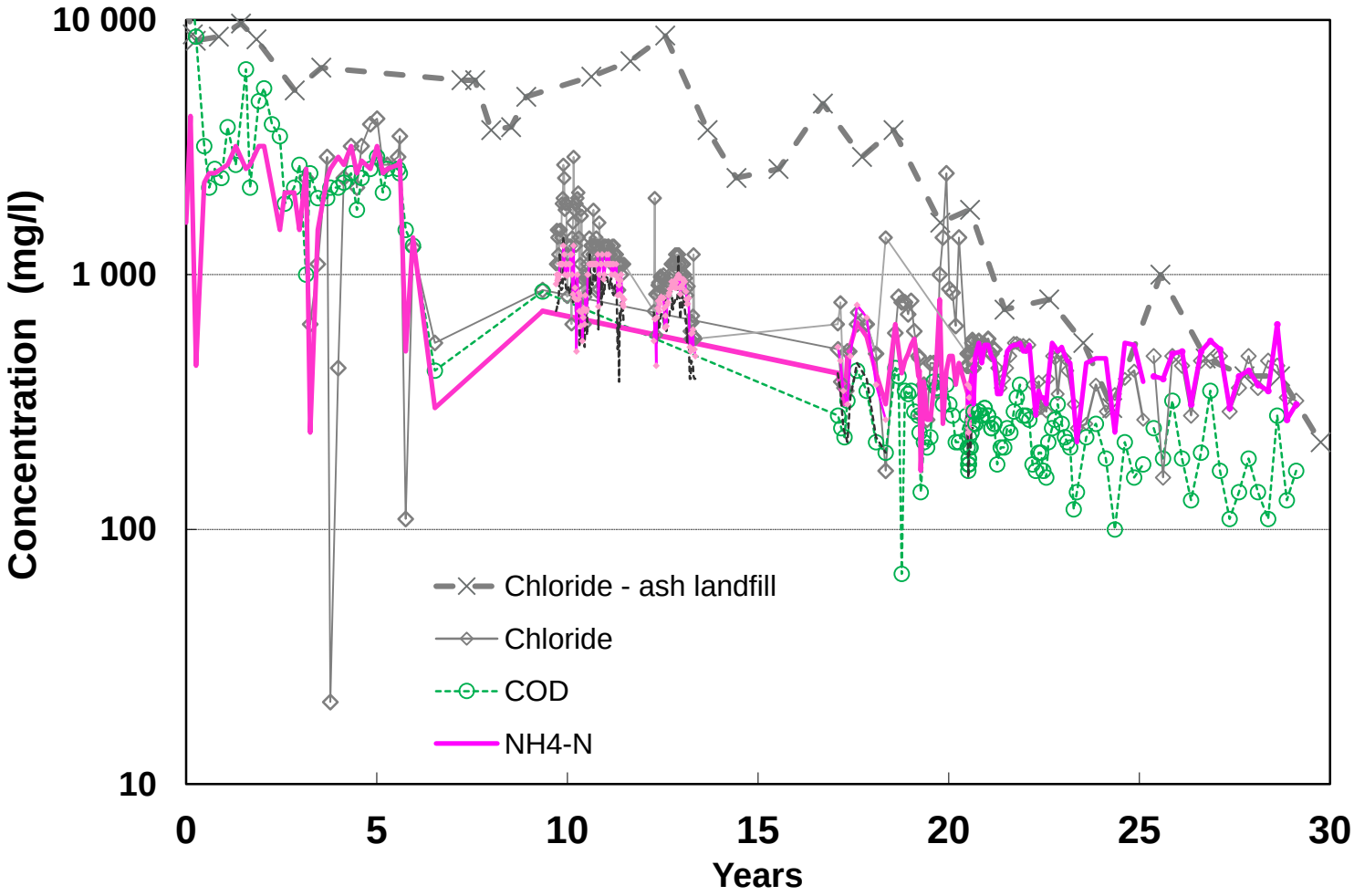
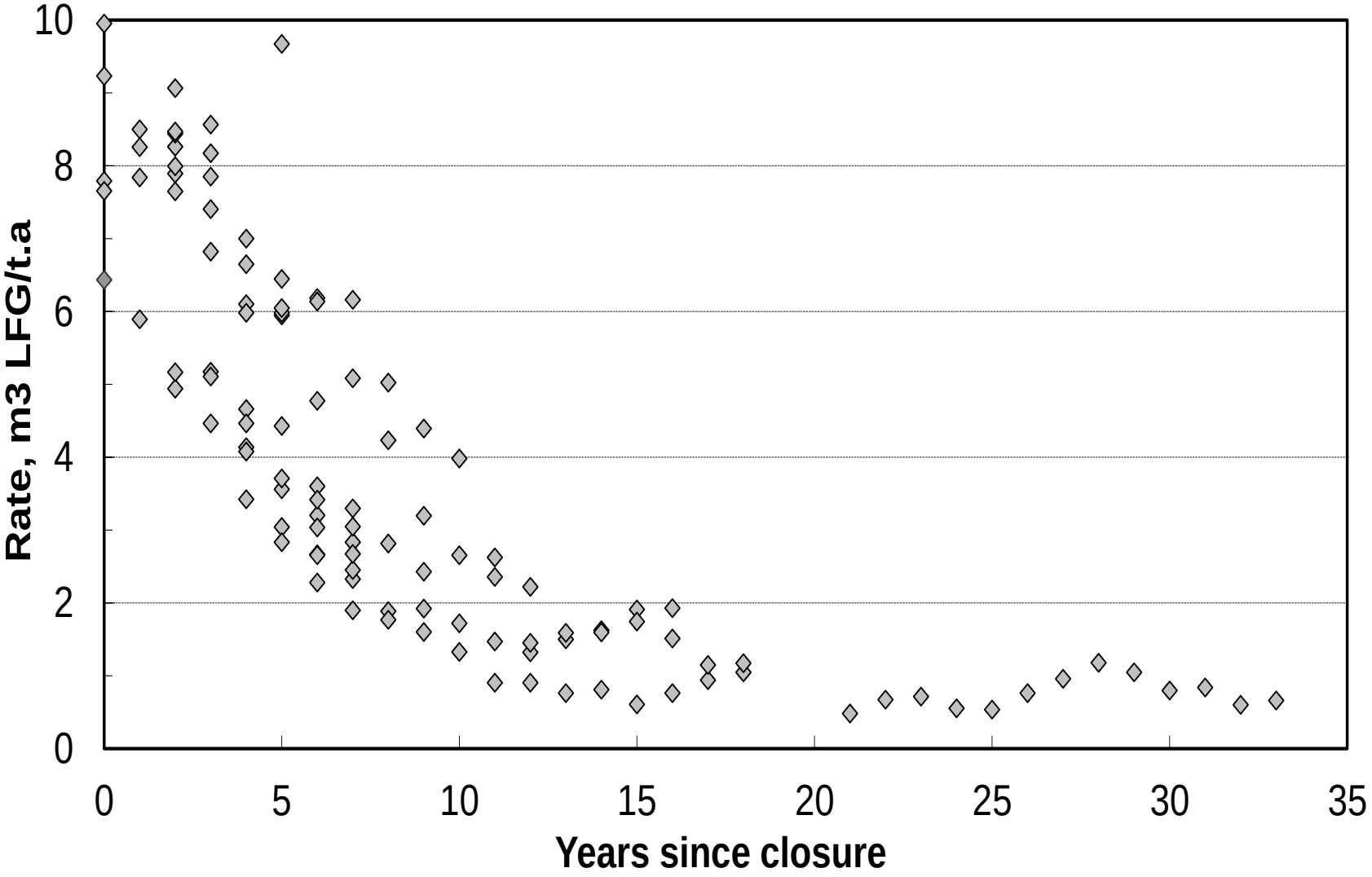
Flushing of Soluble Contaminants



Leachate dilution at full scale landfills with high water inputs (Beaven et al., 2014)

Waste Degradation



Gas generation rates at twenty closed landfills in Hong Kong and UK (from Knox et al.,2011)

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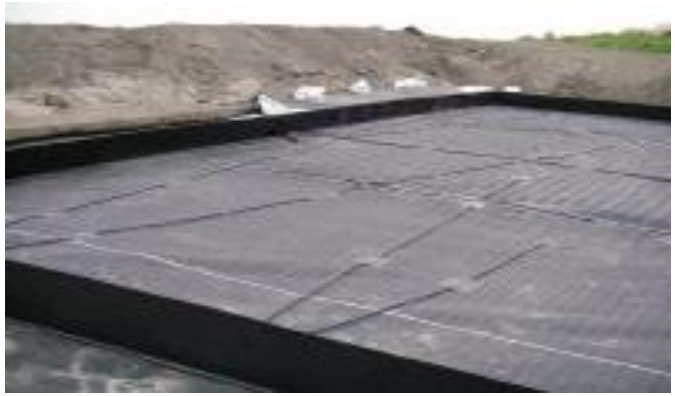
Methane Oxidation

- Methane oxidation in top cover layers has been proposed as a means of treating low rates of gas generation during the prolonged ‘tail’, possibly following in situ aeration.



- However, for both **cost and regulatory reasons**, many operators would be reluctant to remove a low permeability top cover and replace it with a permeable methane oxidising top cover.

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Funding Uncertainty

The financial provisions required to fund the maintenance and monitoring of sites during the aftercare period depend on setting aside a sum whose value at the time the LF closes is equivalent to the NPV of the long-term aftercare costs, which, for LF flushing would be dependent on:

- the length of the aftercare period;
- The discount rate applied;
- The long term cost streams that are affected by:
  - the amount of water required to flush out contaminants to an acceptable concentration;
  - the engineering costs;
  - the cost of water and its treatment;
  - the true hydraulic equilibrium situation.

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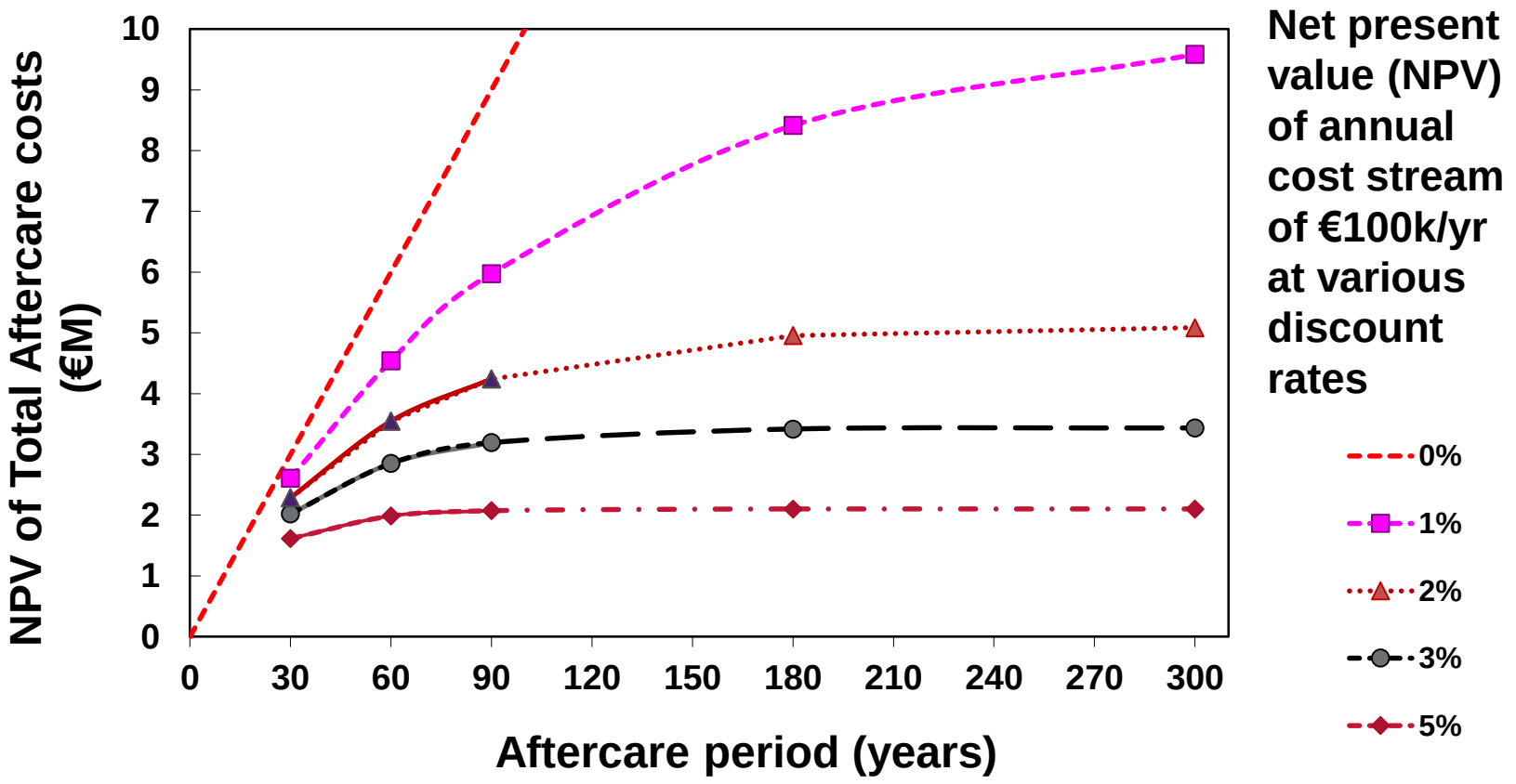
Dependence of NPV on aftercare period and discount rate



In the absence of clear guidance, it is understandable that operators lean towards high discount rates & short aftercare periods when calculating funding liability.

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The Proposal

- The first part of this economic instrument was proposed initially by Beaven & Knox in 2000, to encourage leachate flushing.
- Both depend on there being a landfill tax or aftercare provision and on a proportion of it being directed towards funding measures to shorten the aftercare period.

A rebate payable for:

1. every tonne of nitrogen (or other agreed leachate marker) removed via leachate extracted from the site;
2. for every tonne of non-commercially viable carbon removed via landfill gas collection and treatment.

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Review of Market Based Instruments

- A scheme similar to the Proposal was identified.
- This was a refunded emission payments scheme introduced in Sweden in 1992 to reduce industrial NOx emissions.
- We could adopt elements of the output-based aspects of the rebate used in Sweden.
  - Unless an operator performs better than the industry average in terms of C and/or N removal/t waste accepted, it will lose out by receiving less rebate in comparison to the amount of LF tax it pays.
  - incentives to remove pollutants would be maximised, & technological improvements in accelerated waste stabilisation would be stimulated.

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Tentative comparison between Swedish NOx charge and UK landfill tax plus rebate

Application of Refunded Emission Payments	Refunded NO_x emissions charge in Sweden	Landfill tax plus rebate in the UK
Policy target	Minimise NO_x emissions per unit of energy produced	Maximise removal of releasable N and/or non-commercially viable C per unit of waste intake.
Charge base	NO_x emissions	Waste intake
Rebate base	Energy output	N &/or C removal

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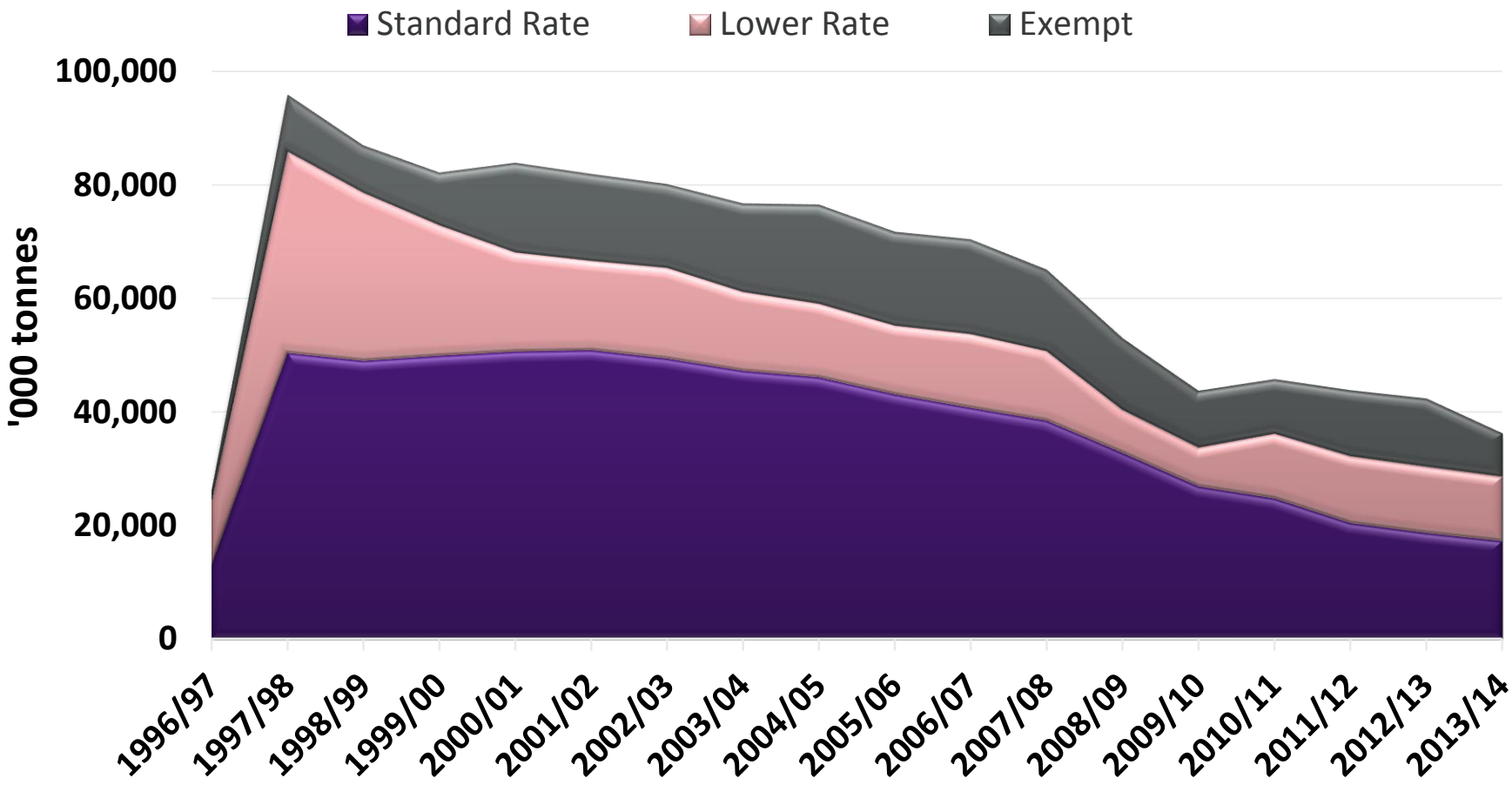
Results of the Landfill Tax



The amount of waste received at landfills in the UK related to type of landfill tax from 1996/7 to 2013/14 (HMRC,2014)

Political Commitment towards Revenue Neutrality

Central to its design, the UK LFT was intended to be revenue-neutral for businesses as a whole.

- Revenue should be recycled back to businesses via other channels.
- This commitment was reiterated in numerous official reports *.

- The additional LFT burden on businesses was compensated for by a **one-off** reduction in employers' higher rate NICs of 0.2% in 1996.
- Using data from HMRC, the following table has been constructed to show that despite the original intention as stated by government regarding revenue neutrality, **such a commitment has not been fully realized.**

** See Seely, 2009; HMRC, 2003b; HMRC, 2003a; HMRC, 2002*

Landfill Tax Revenues (1999/00 - 2013/14)

£ million	LFT Revenues*	LFT Collected after LCF Deduction	Value of 0.2% cut in Employers NICs**	Revenues Not Recycled *** (net)
1999-00	442.0	349.3	112.7	236.6
2000-01	476.2	367.0	121.2	245.8
2001-02	508.0	380.9	126.3	254.6
2002-03	538.2	407.9	129.1	278.8
2003-04	637.6	591.8	144.9	446.9
2004-05	667.8	623.0	156.2	466.8
2005-06	743.4	697.2	171.0	526.2
2006-07	817.1	762.2	174.5	587.7
2007-08	880.4	821.1	200.8	620.3
2008-09	986.2	925.3	193.8	731.5
2009-10	1,018.1	955.0	191.0	764.0
2010-11	1,143.4	1,078.6	193.1	885.5
2011-12	1,101.3	1,032.6	203.2	829.4
2012-13	1,150.0	1,083.9	204.1	879.8
2013-14	1,234.2	1,154.7	215.4	939.3

* LFT revenues based on declarations on trader returns.
** 0.2% cut applied to all employers' NICs, not just those subject to higher rates; thus overestimates loss of revenue.
*** Underestimates, because the opportunity costs of cuts in NICs have been overestimated.

£8,693 m

Trends in non-hazardous landfill gate fees (excluding tax) in the UK

- Current UK gate fees are too low to enable complete removal of emissions potential.
- Costs of flushing, treatment of NH_4-N and of non commercially viable carbon: **€24.8 - € 48.7 per tonne of MSW.**

Assessment of expected benefits of the Proposal

- Theoretical cost savings:
  - reduction in releasable nitrogen &/or non-commercially viable carbon required for waste to reach FSQ can be achieved at the lowest costs possible.
- Conformity with the polluter pays principle.
- Coherence with the landfill diversion targets.
- LAs and businesses would be paying no less than they are today to dispose of waste to landfill.
- Incentives to divert waste towards other preferable treatment technologies would remain intact.

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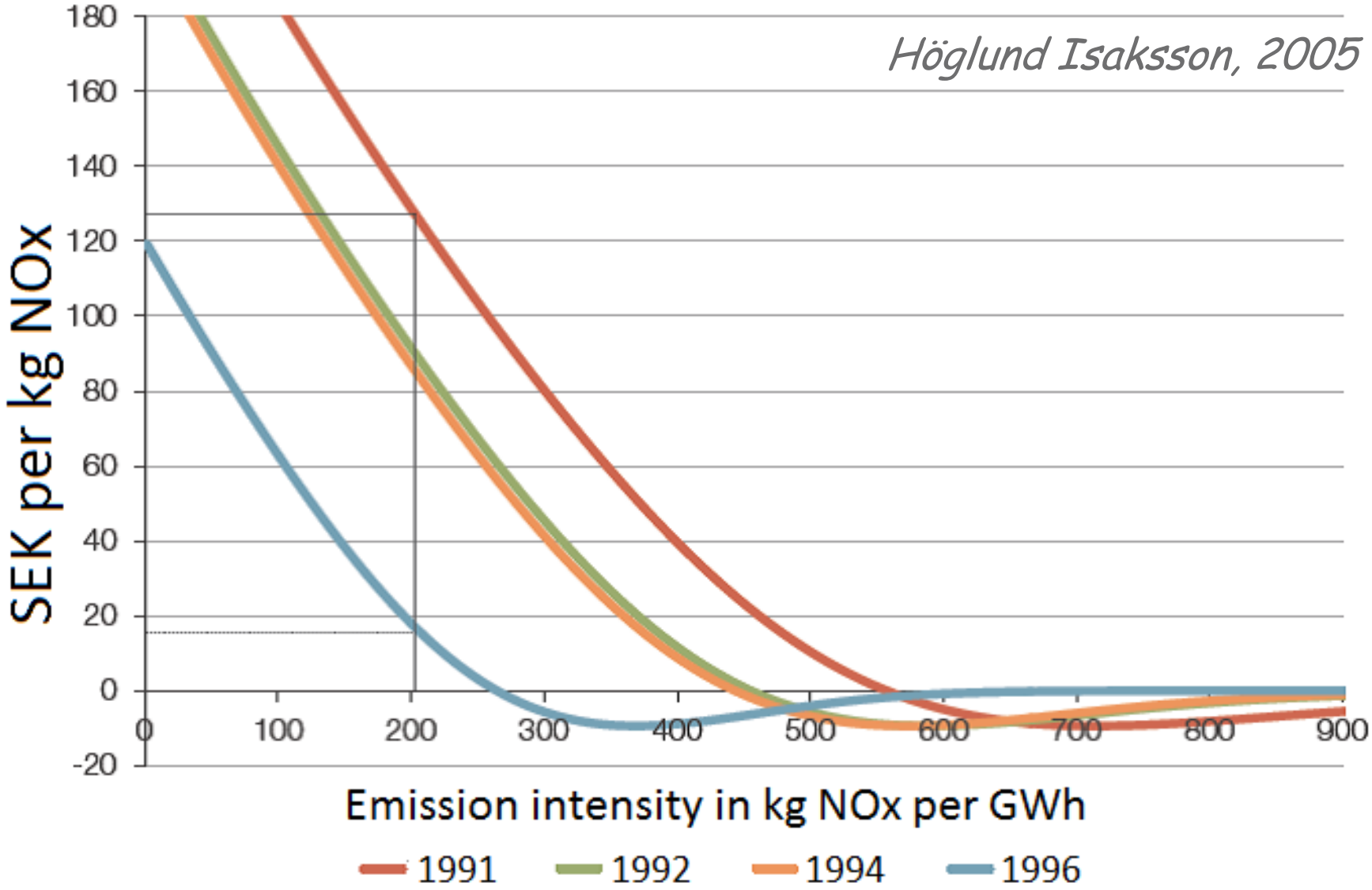
Falling NOx abatement costs in the Swedish energy sector



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Assessment: potential drawbacks

- Administrative costs
  - A fixed rebate might need constant revision & might jeopardise existing landfill tax mechanism.

    Both would be largely addressed if a proportional rebate, based on individual share of total effort were adopted.
  - The need for a clear definition of FSQ remains unaddressed.
  - No defined boundary between commercially viable and non-commercially viable carbon.
- Uncertainty in distribution of funding between two separate rebate mechanisms – carbon and nitrogen.
- Possible hindrance to technological diffusion ∵ of cap on total funds and the output-based nature of the rebate.

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Comments

Aberdeen City Council, 2014

- It is unlikely that both parts of the proposal could be operated under this scheme.
- It might be possible for FPs to contribute to the funding of the scheme but details of FPs are much more difficult to obtain.
- There is a chance that an FP system could operate as a deposit/refund system.
- Whatever the mechanism, **we really can't leave things as they are.**

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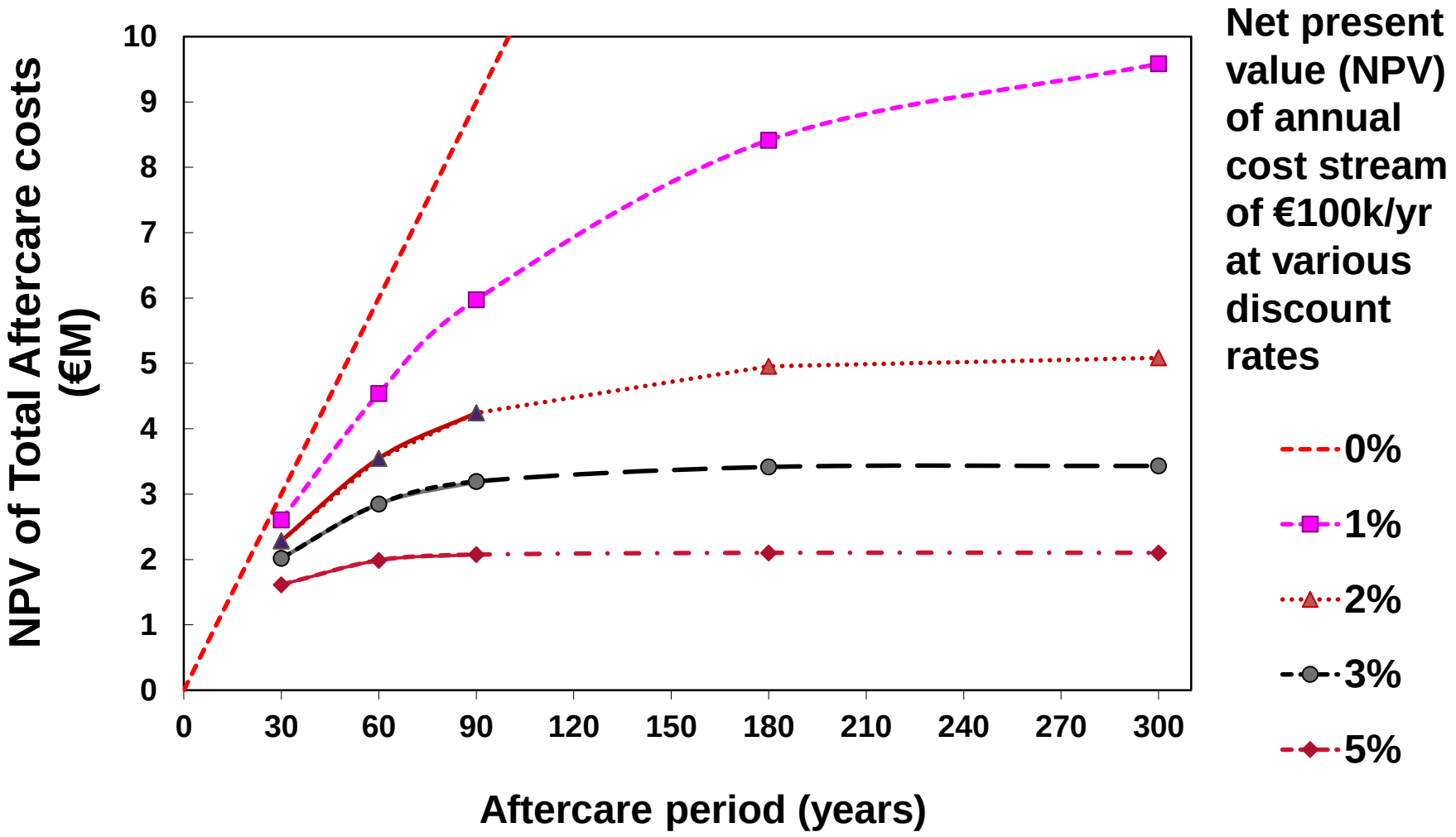
The Steve Lee Question: what is the amount of unfunded liability in the UK



The amount of unfunded aftercare liability in the UK?

Item	Value	Units
Assume average discount rate used in UK aftercare calculations	3	%
Postulate that appropriate discount rate should be:	1	%
Assume average funding period in UK aftercare calculations	60	yrs
Postulate that appropriate aftercare period should be:	300	yrs
Assume initial median annual aftercare cost/site is (present value)	100	€k/a
Assumed real annual median cost per site falls after year 60 to 50%	50	€k/a
Interpolating from previous slide, we get:		
NPV of €100k/a at 3%, 60 yrs	3	€M
NPV of €100k/a at 1%, 60 yrs	4.5	€M
So shortfall per site, 0-60 years	*1.5*	€M
NPV of €100k/a at 1%, 300 yrs	9.5	€M
NPV of €50k/a at 1%, years 61-300	2.5	€M
So shortfall per site, 61-300 years	*2.5*	€M
So, NPV of combined shortfall, 0-300 years	4	€M
Assume number of affected landfills in UK	2,000	
Then, national shortfall would be	8,000	€M