Prioritisation of ammonia abatement measures, their costs and impacts on nitrate leaching and nitrous oxide emissions using the NARSES model

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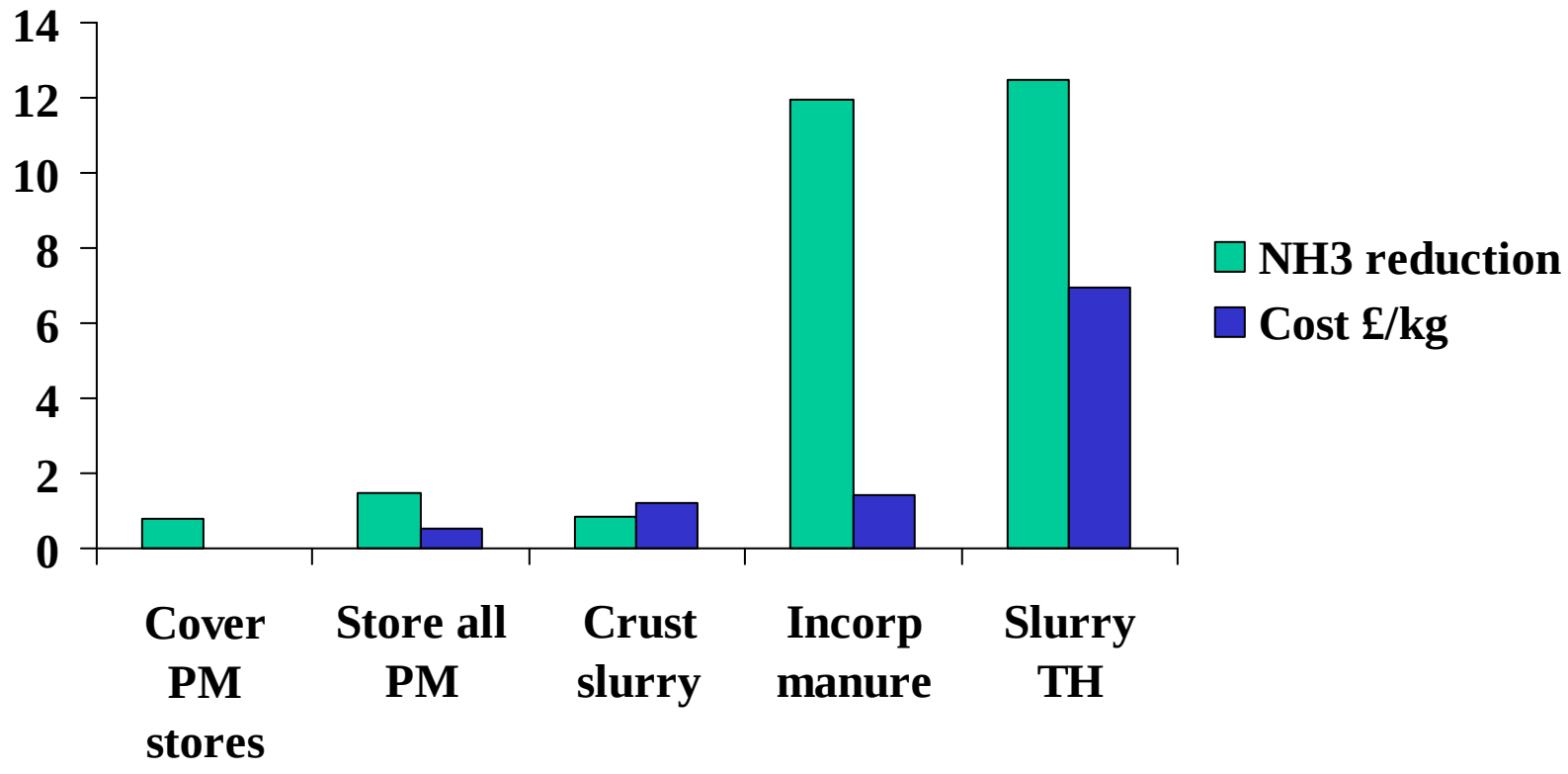
Materials and Methods

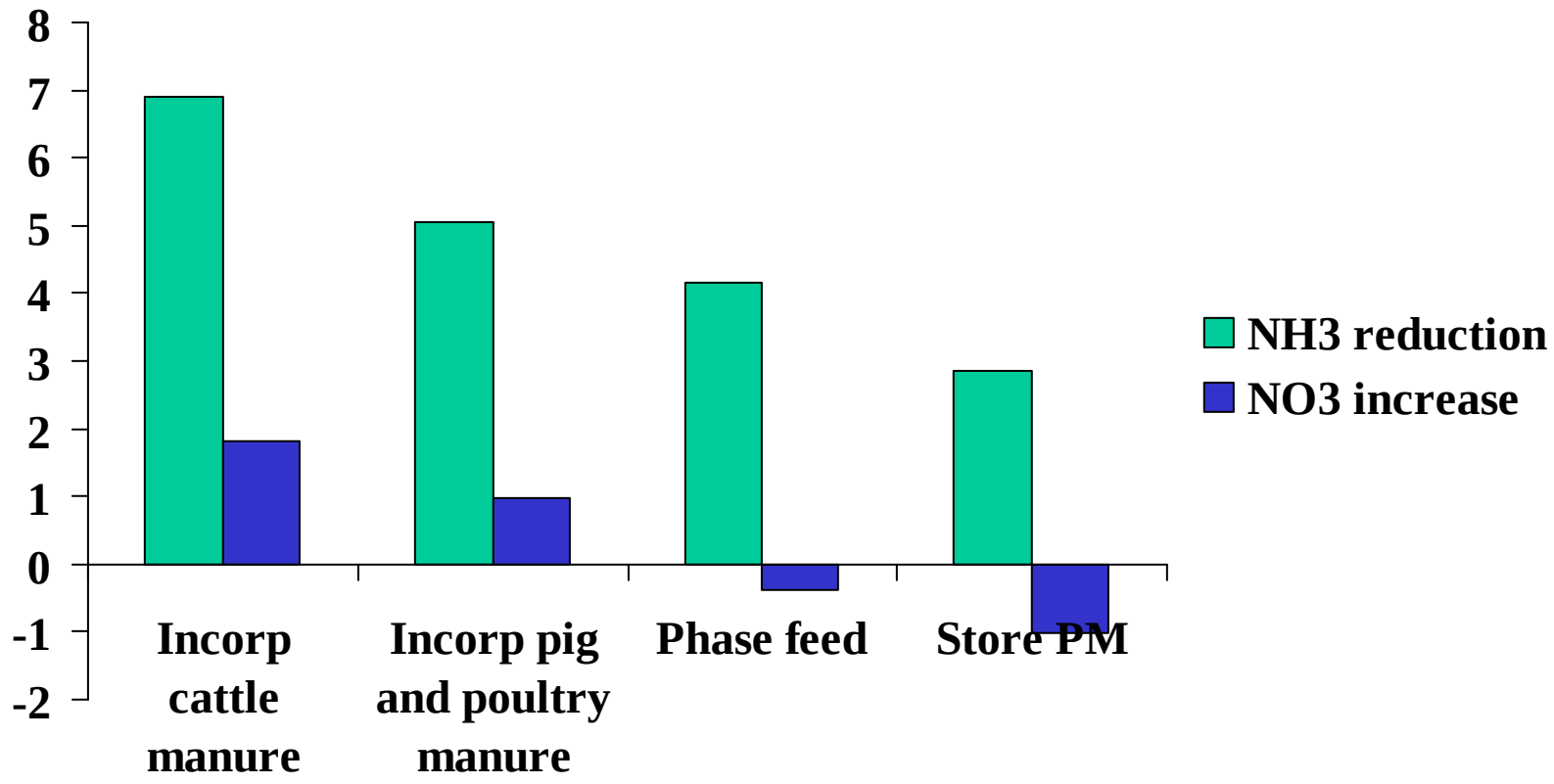
- NARSES uses a mass-flow approach to identify the most cost-effective means of reducing ammonia (NH_3) emissions from agriculture
  - and to make unbiased estimates of the total costs
- NARSES output is now linked to the MANNER model
  - enabling calculation of the impacts of NH_3 abatement on NO_3^- leaching and N_2O emission

Ammonia reduction and unit cost



Impact on nitrate leaching

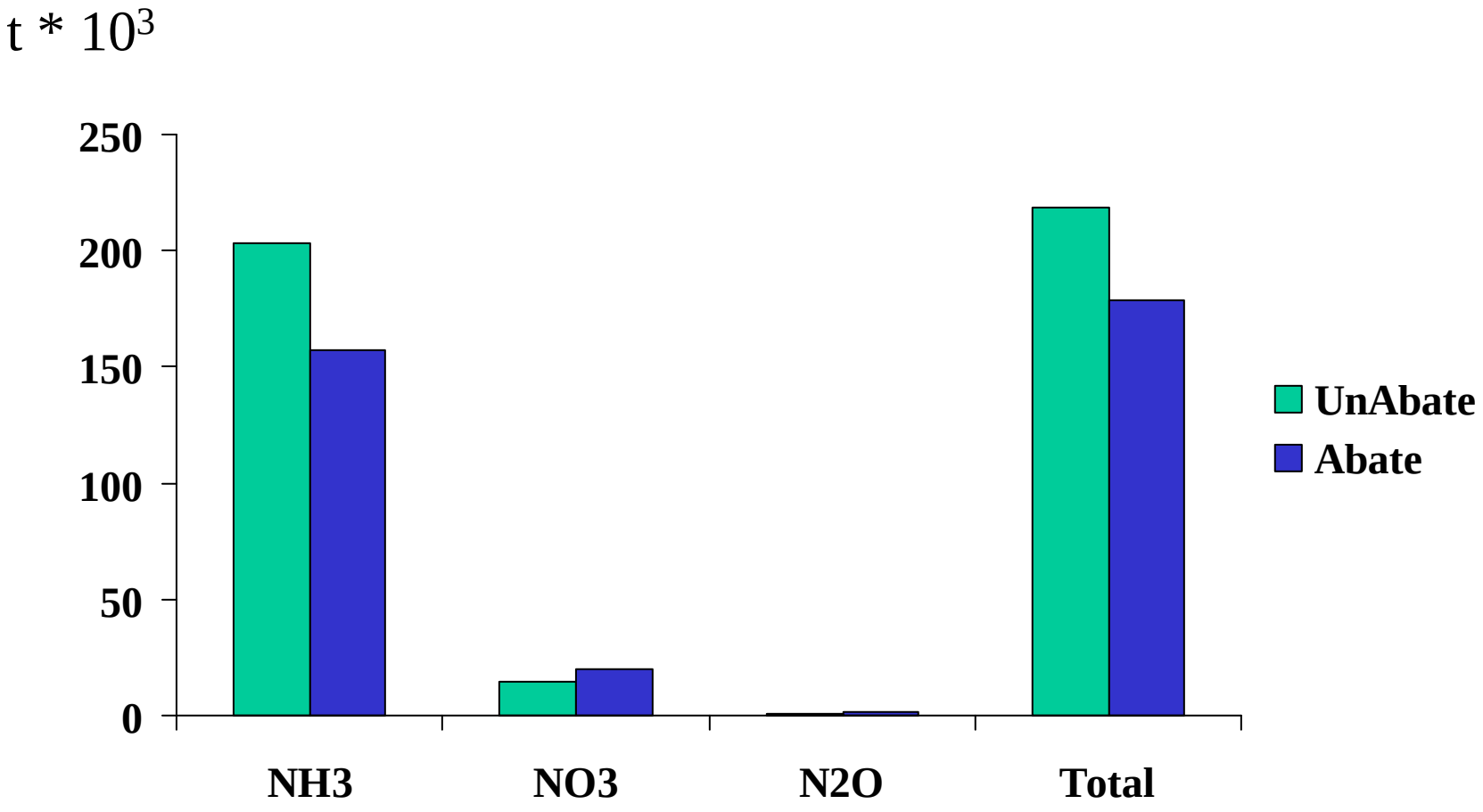
kg *10^3



Nitrous oxide emissions

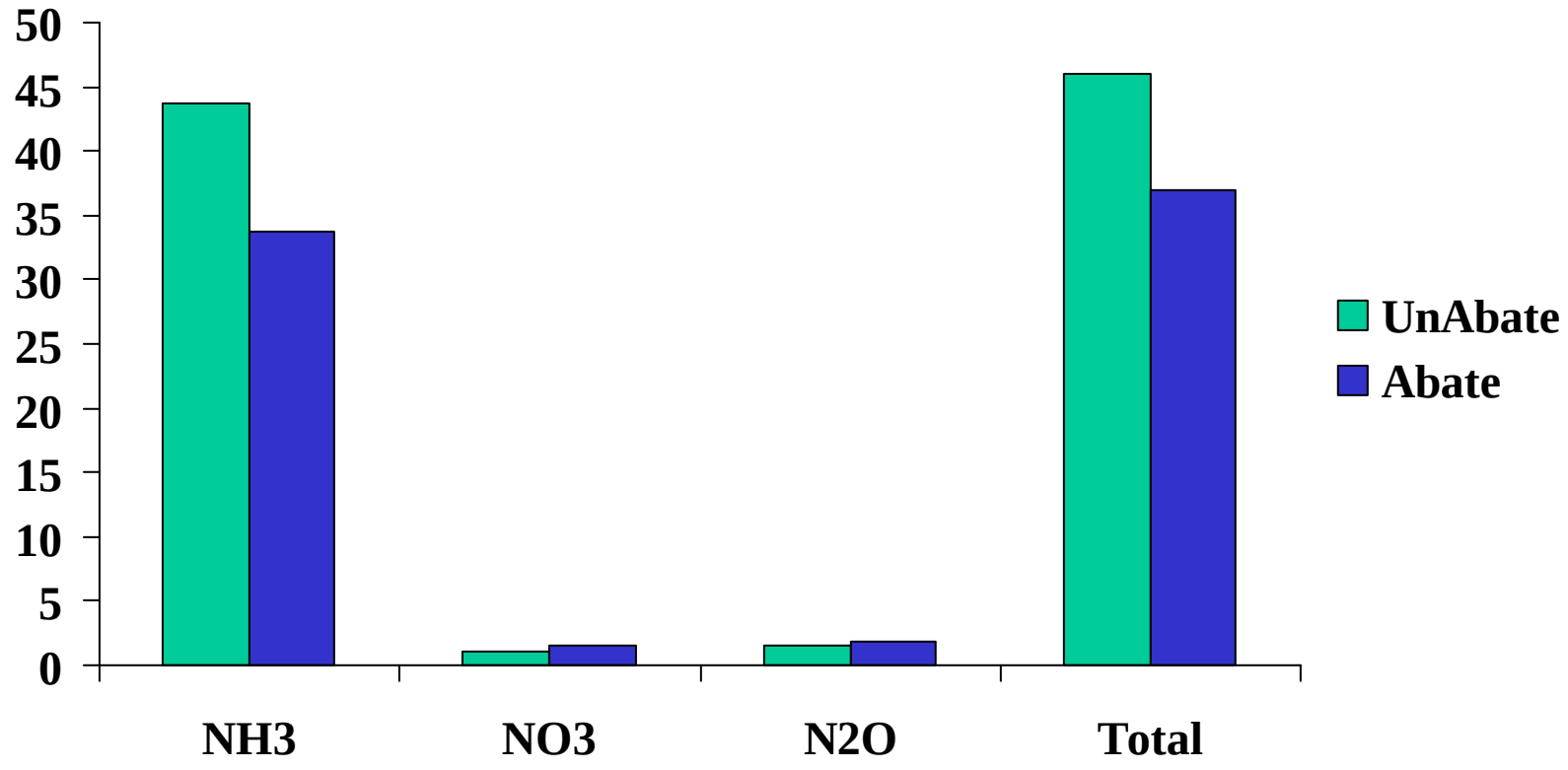
- The increase in N_2O emissions was never more than 2% of the NH_3-N conserved
- phase feeding and storing manures decreased N_2O emissions following manure spreading
- total N_2O emissions were little changed by the adoption of NH_3 abatement techniques

Total N losses from manure

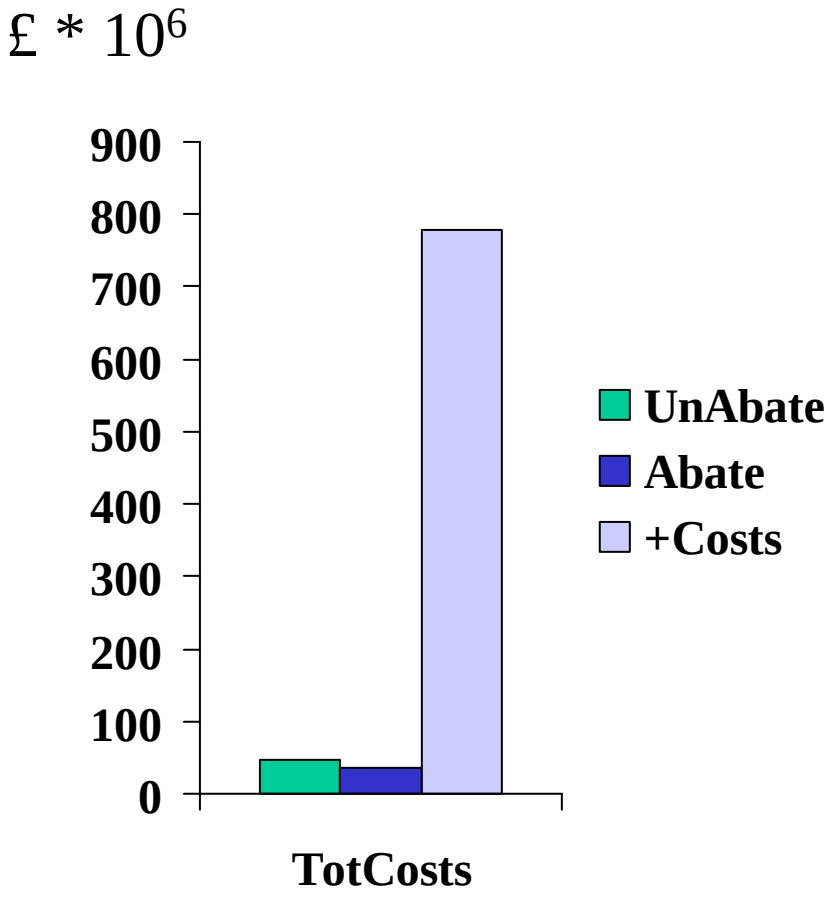


Total environmental costs

£ * 10^6



Costs including total abatement costs



- Based on the environmental costs used
- a total NH_3-N abatement of only 10.45 $t*10^3$ justified
- but the environmental costs need updating

Conclusions

- At the national scale, UK NH_3 emissions can be conserved without large increases in NO_3^- leaching
- no method of abatement led to more than 30% of the NH_3-N conserved being lost as NO_3^-
- some NH_3 abatement methods also *decreased* emissions of both $NO_3^-$and N_2O
- in those catchments with the greatest potential for NO_3^- leaching, careful consideration will still need to be given to the implementation of an NH_3 abatement policy

Conclusions

- A policy to reduce NH_3 emissions could lead to a net decrease in N releases to the environment
- and would reduce the overall impacts to the environment

Results
Ammonia abatement

- Covering poultry manure stores
- allowing cattle slurry lagoons to crust
- store all poultry manure prior to spreading
  - simple and inexpensive to adopt
  - each produce only small (< 1.0×10^3 t or less) reductions in NH_3 emission
- rapid incorporation of manures and slurries gave greater reductions
  - reasonably cost-effective
- apply slurry to grassland by trailing shoe

Impact on nitrate leaching

- Of the NH_3-N conserved (46 x 10^3 t), *c*. 5.3 x 10^3 t, was calculated to be lost as NO_3^--N
- an increase of *c*. 37% in the amount of NO_3^- leached following the application of livestock manures
- but only *c*. 4% of current total NO_3^- leaching in the UK
- in some catchments, vulnerable to leaching, increase in NO_3^- losses will be greater and be cause for concern.

Impact on nitrate leaching

- Increases in NO_3^- leaching occurred following measures which conserved NH_3-N as TAN
- two types of measure decreased NO_3^- leaching as well as NH_3 emission
  - phase feeding of pigs would be expected to decrease all forms of N loss
  - storing all FYM and poultry manure before spreading
  - storage emits *c*. 12-41% of TAN entering the store as N_2O or N_2 and hence less TAN remains when the manure is applied to land than would have been the case if the manure was spread when 'fresh'.