



## Multi-criteria decision analysis

A case study for ammonia abatement from livestock farming (including changes in human consumption)

N. Hasnain, H.M. ApSimon, T. Oxley  
Imperial College of Science, Technology and Medicine

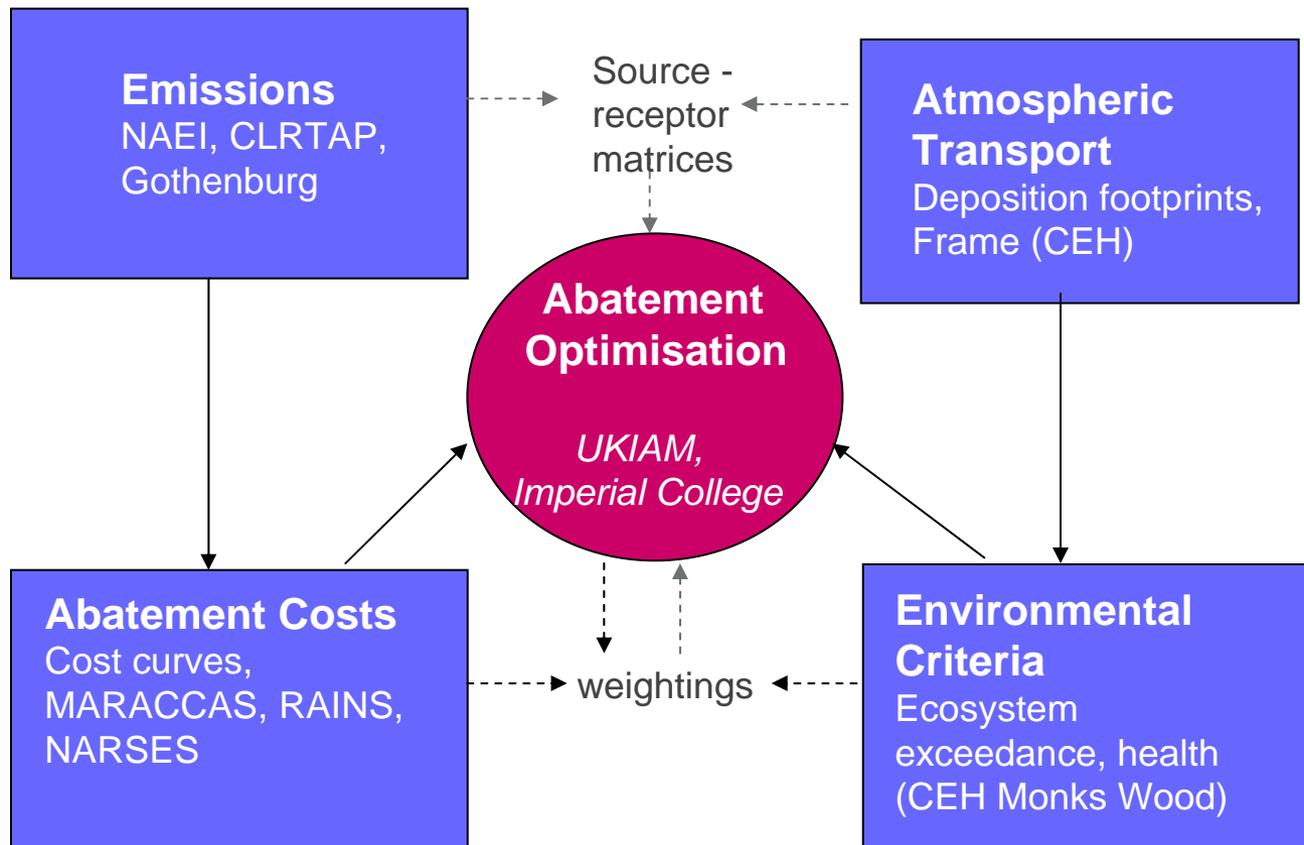
**A broader approach to NH<sub>3</sub> abatement covering different stakeholder interests**

**-> multicriteria analysis as a complementary tool to integrated assessment modelling**

**Illustration for some basic scenarios**

**Extension to scenarios with changes in human consumption and diet for meat**

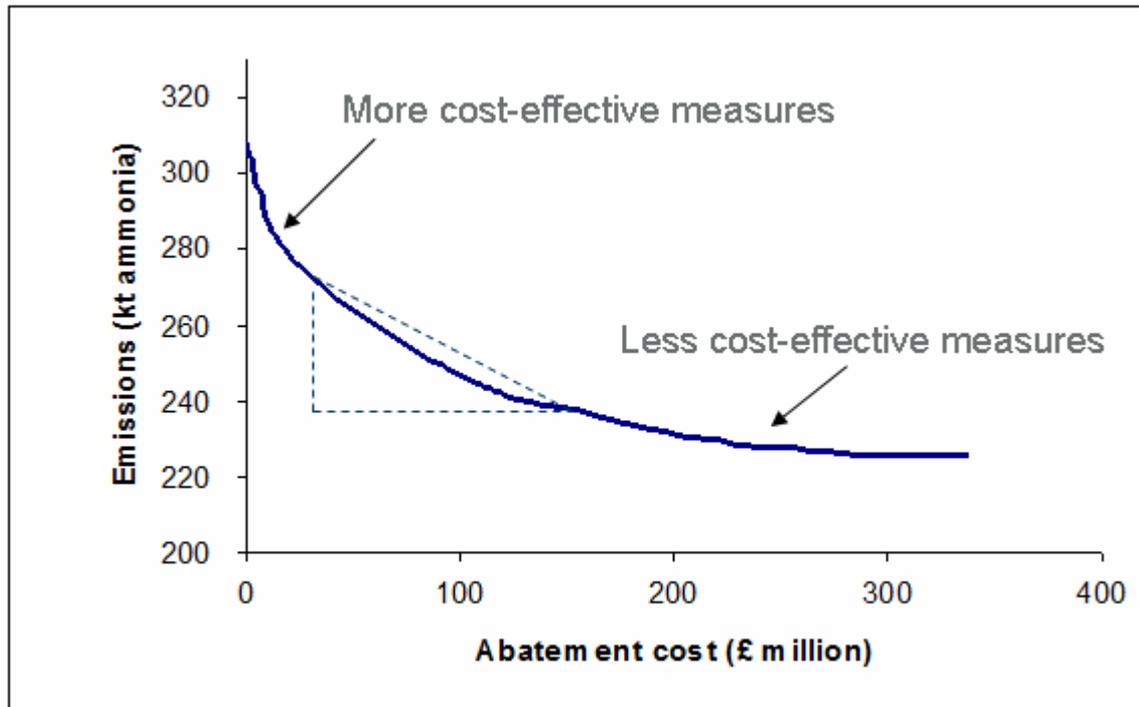
# Simplified architecture of integrated assessment models



Modified from Oxley et al. 2003

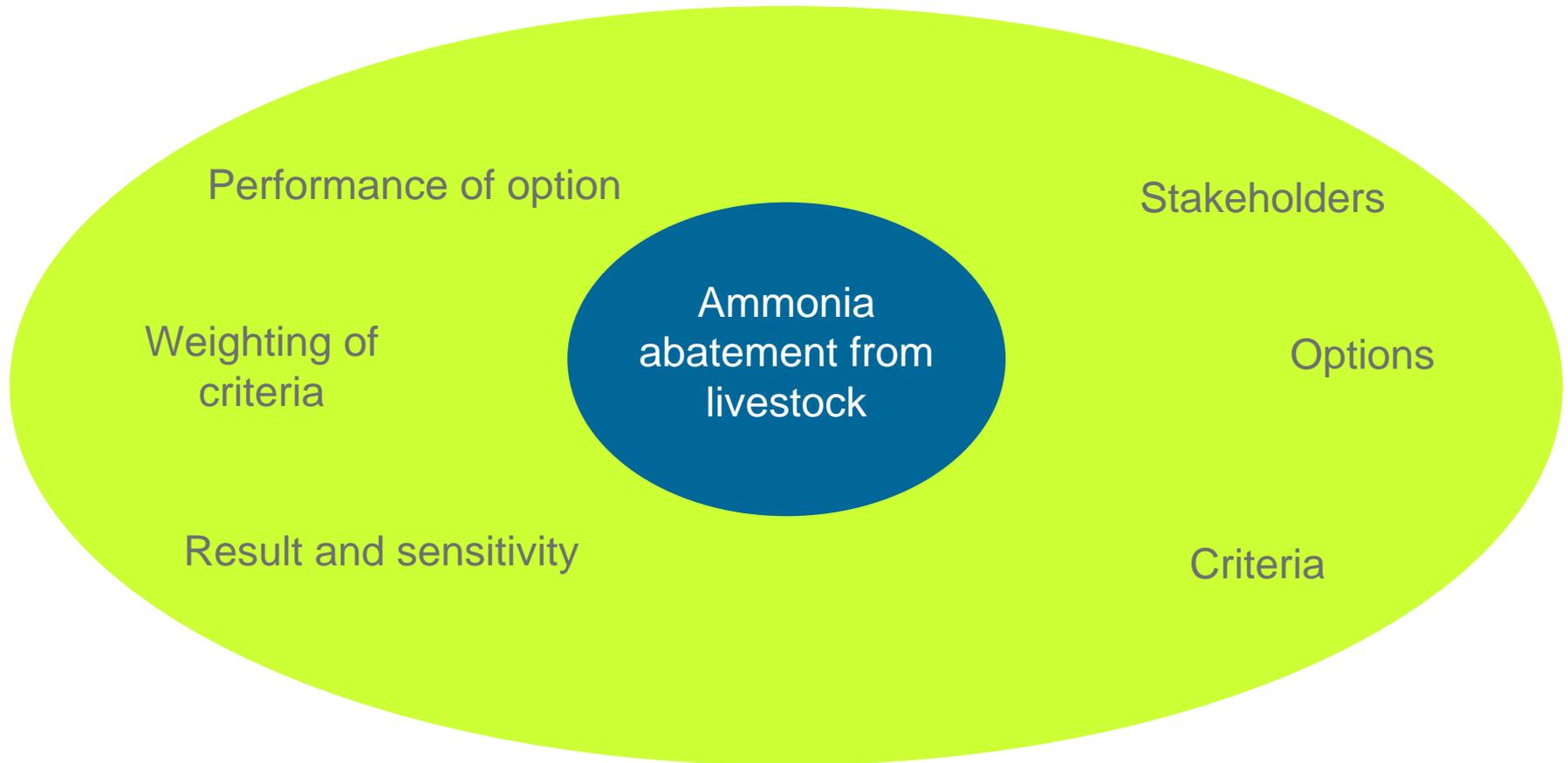
# Integrated assessment models

## NH<sub>3</sub> abatement options summarised in cost curves (technical measures)



Courtesy Tom Misselbrook, North Wyke Research, 2008

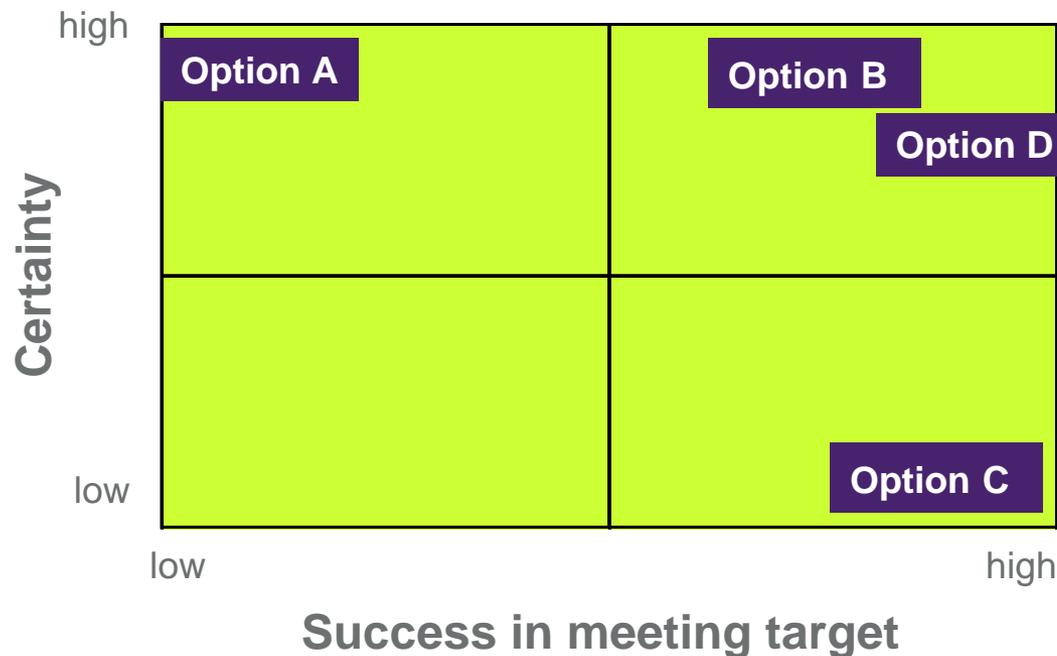
# Multi-criteria decision analysis framework: Widening the analysis



## Case study for the livestock sector for 2020

Goal – 2010 ceiling 297 kt ammonia, tighter ceilings for 2020

Stakeholders

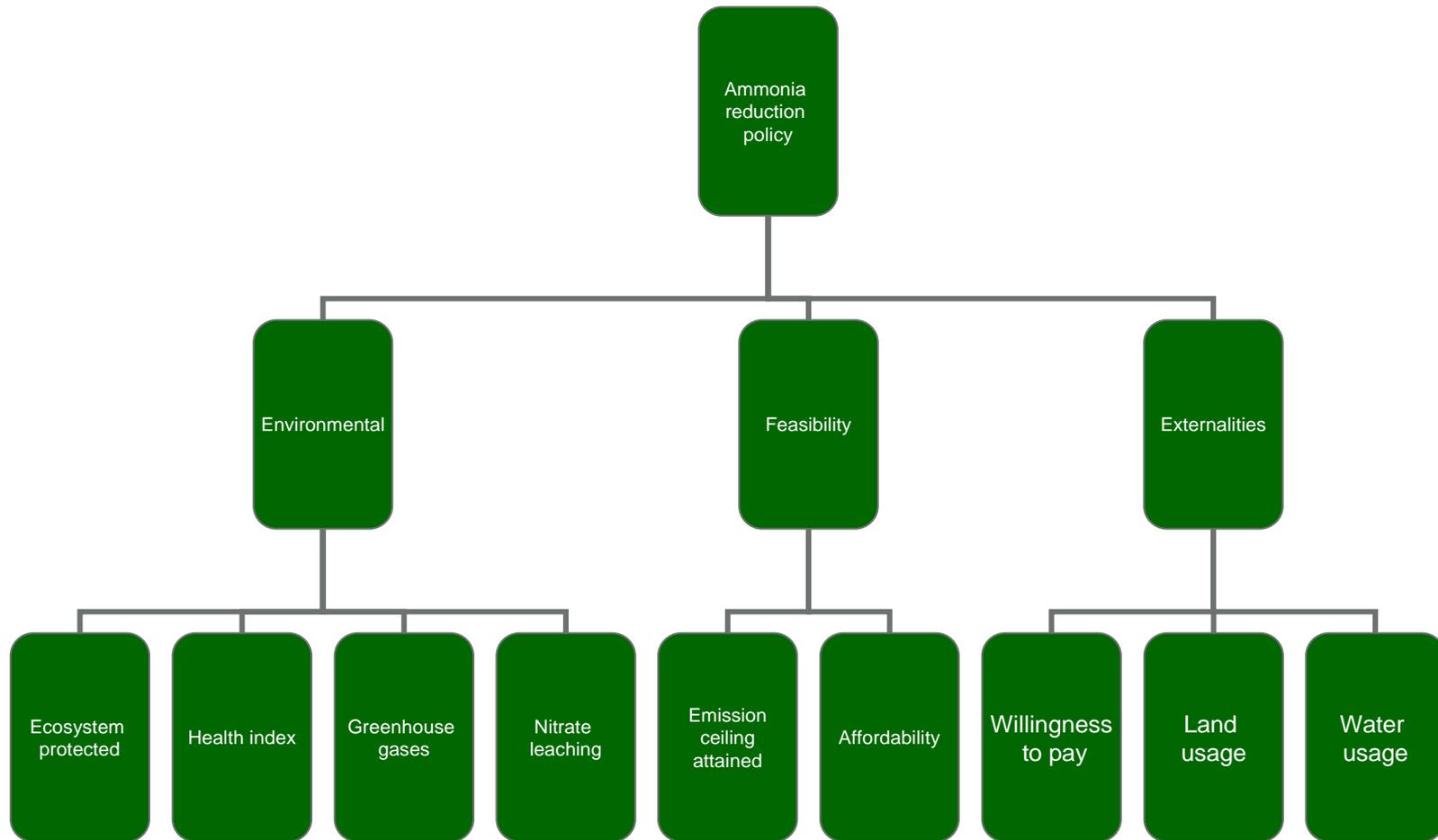


**Option A:** Current legislation

**Option B:** Extended current legislation

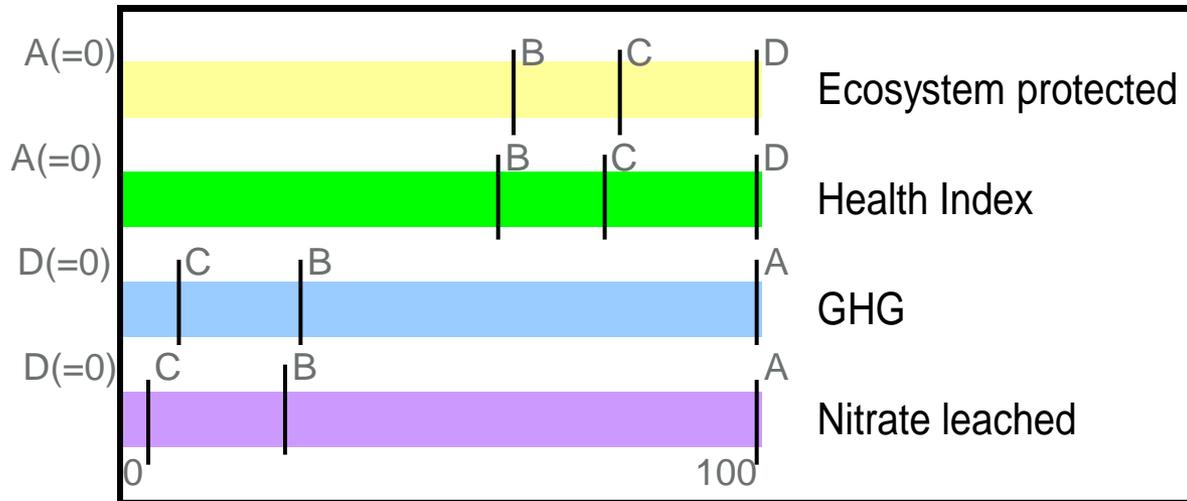
**Option C:** Most cost-effective measures to meet target

**Option D:** Cost-effective measures going beyond target

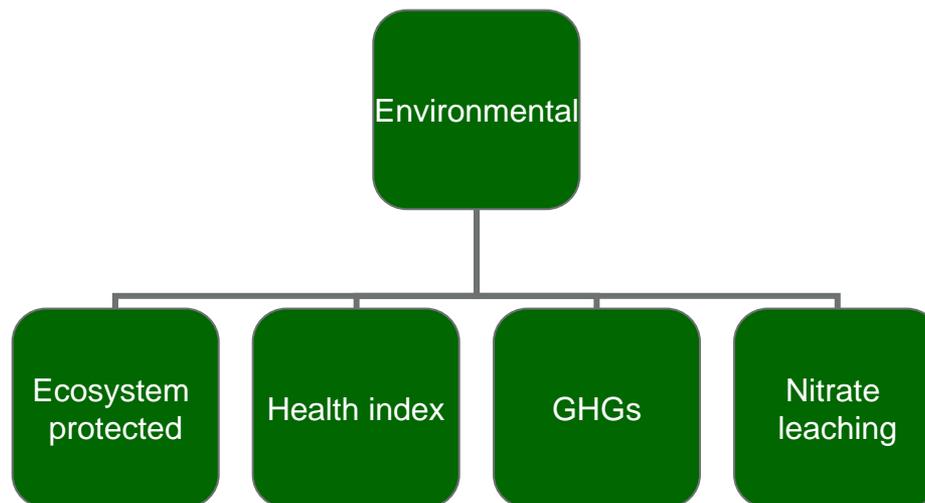


Suitable indicators for criteria - data availability

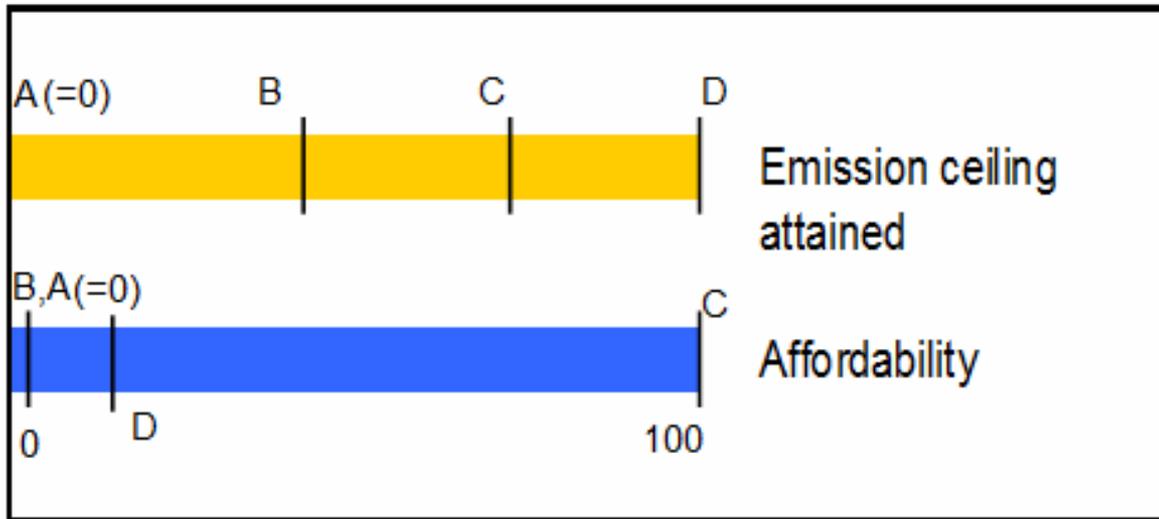
# Performance of option on criteria: Environmental



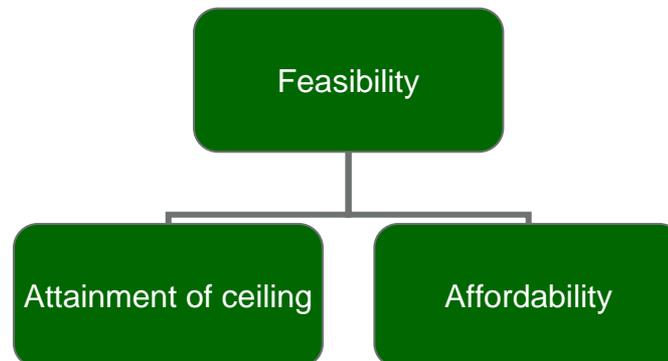
- Option A:** Current legislation
- Option B:** Extended current legislation
- Option C:** Most cost-effective measures to meet target
- Option D:** Cost-effective measures going beyond target



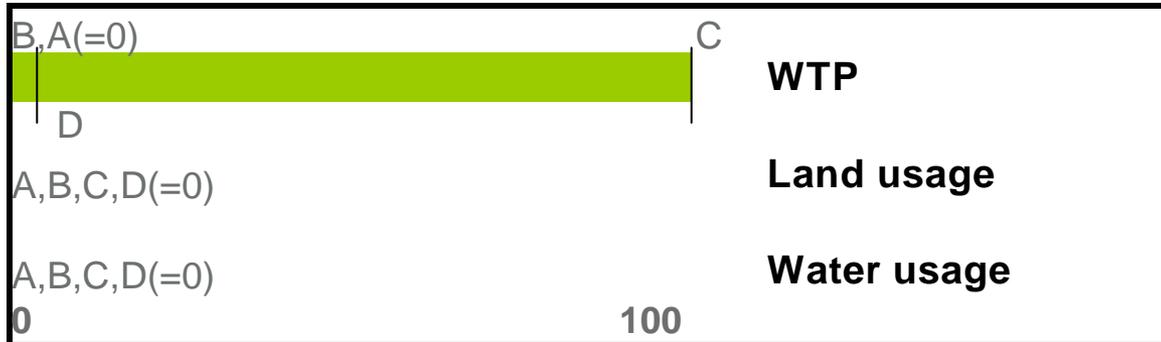
# Performance of option on criteria: Feasibility



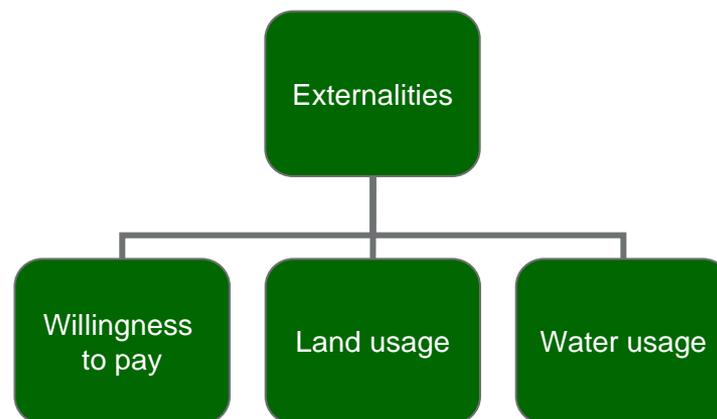
- Option A:** Current legislation
- Option B:** Extended current legislation
- Option C:** Most cost-effective measures to meet target
- Option D:** Cost-effective measures going beyond target

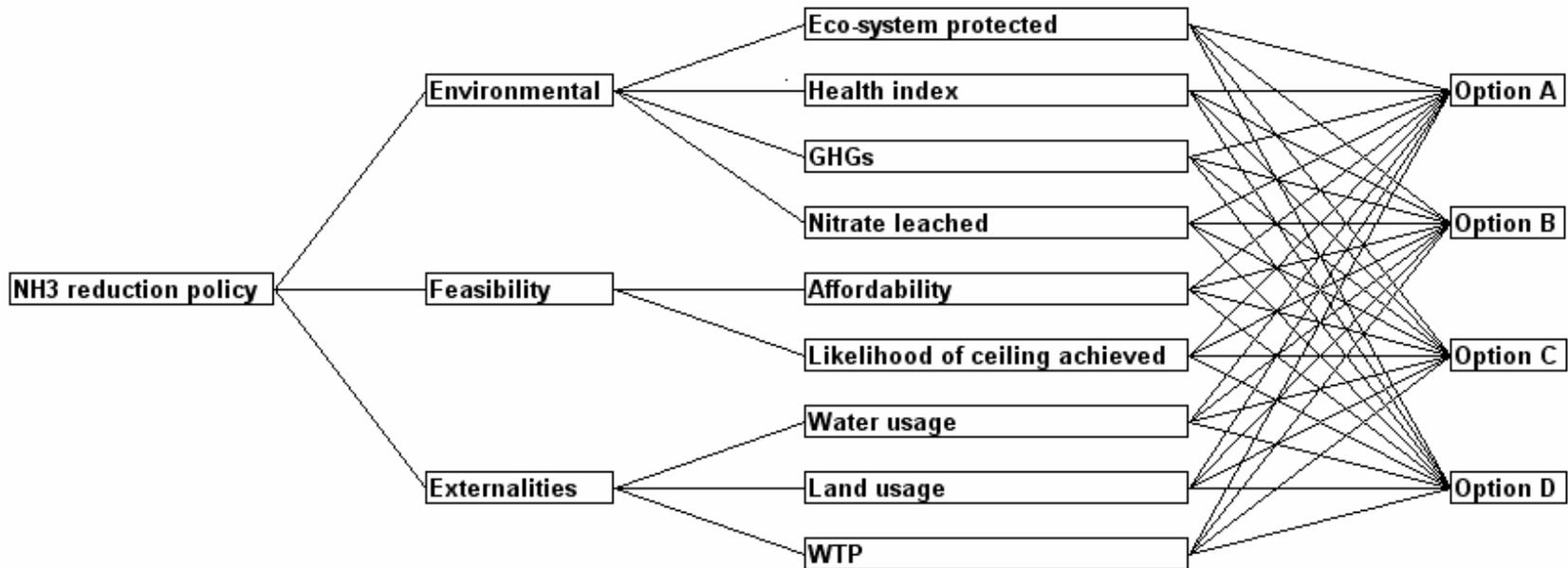


# Performance of option on criteria: Externalities



- Option A:** Current legislation
- Option B:** Extended current legislation
- Option C:** Most cost-effective measures to meet target
- Option D:** Cost-effective measures going beyond target



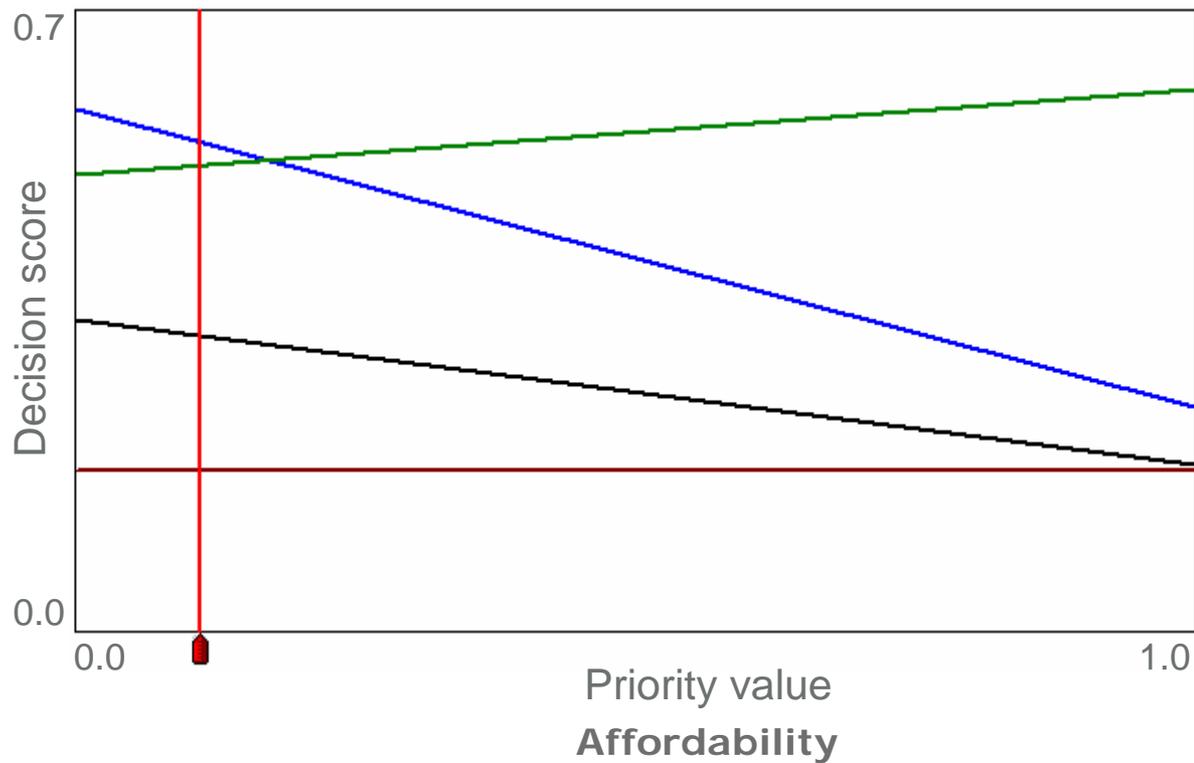


- Weight each criteria
- Aggregate performance value and weight to get overall value for each option



# Results: Sensitivity analysis

How sensitive is the final choice to the weightings given?



Alternatives:

**Option D:** Cost-effective measures going beyond target

**Option C:** Most cost-effective measures to meet target

**Option A:** Current legislation

**Option B:** Extended current legislation

**Current value: 0.11**

**Cross-over value: 0.17**

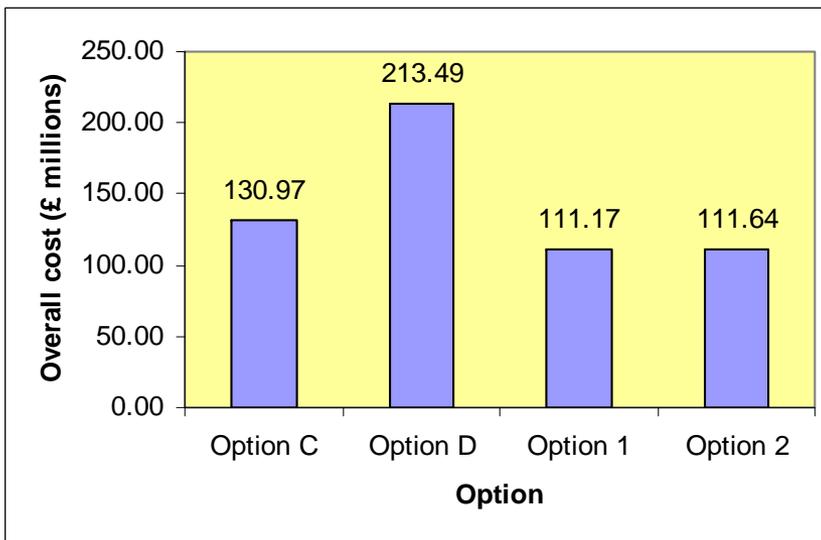
Forecasting of national activity levels post CAP has not taken changes in consumer behaviour and human diet into account

There are many examples of changes  $>10\%$  in consumption of food products e.g. beef

WTP studies can be used as indications of what the public are willing to pay for “environmental” products

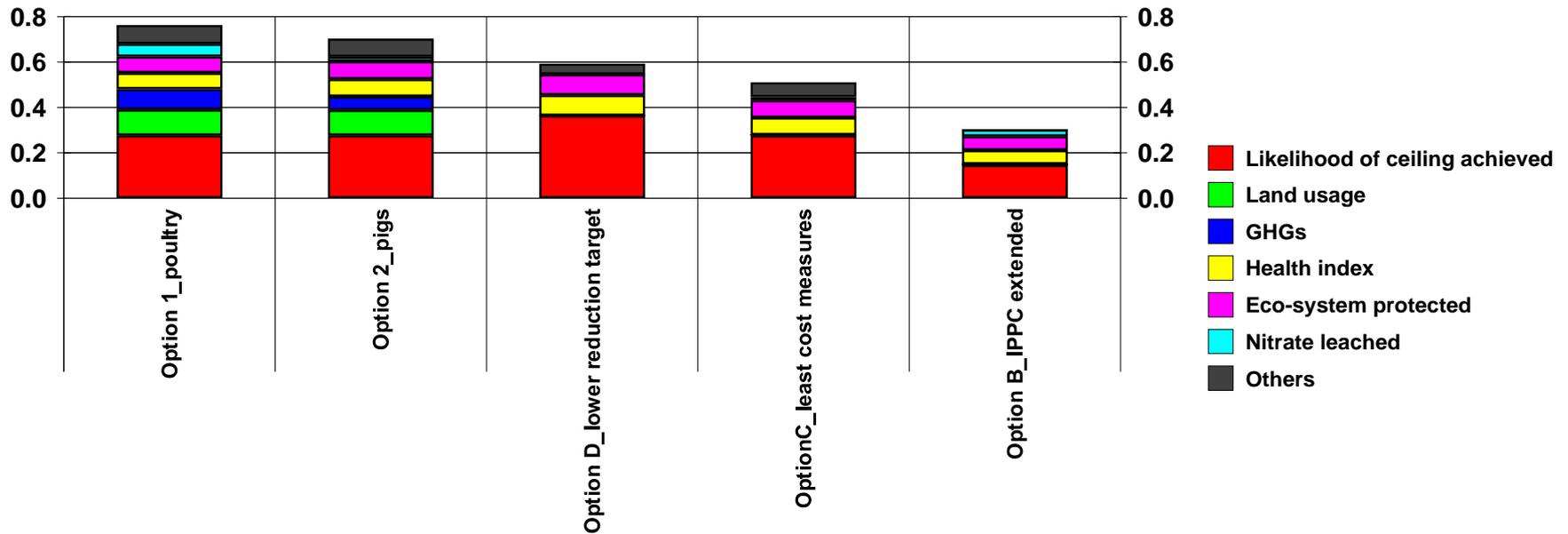
# Externalities: Changes in consumer behaviour -> additional scenarios

- No reduction in total meat consumption
- Same emission target based on IIASA studies



- Option C:** Most cost-effective measures to meet target
- Option D:** Cost-effective measures going beyond target
- Option 1:** Poultry meat substitutes 10% reduction in beef consumption
- Option 2:** Pig meat substitutes 10% reduction in beef consumption

Contributions to NH3 reduction policy from Level:Level  
3



Easier to achieve overall target – more favourable than the most stringent measure, Option D

## Conclusions

- Analysis widened, more holistic decisions using MCDA approach
- Representing different stake holder interests -greater consensus

## Changes in consumer behaviour

- Changes in diet can reduce costs for abatement measures and show other benefits as well compared with reliance on technical measures

**Thank you**