

# **Cost effectiveness of greenhouse gas policies to 2027**

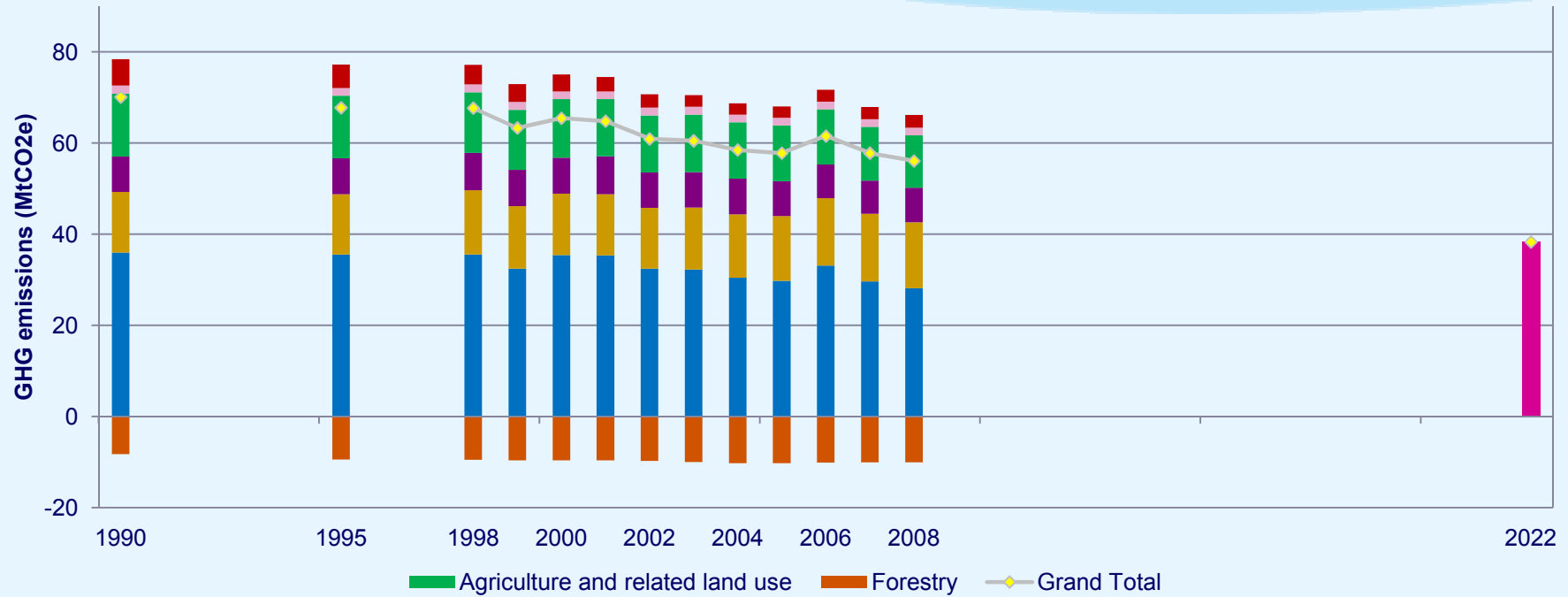
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**Agriculture and Climate Change Workshop**  
**7/10/2011**

## Topics covered

1. Scottish GHG emissions and targets
2. Climate change policies for agriculture
3. MACC (Marginal Abatement Cost Curve)
4. Policy assessment, RPP1
5. RPP2 – preliminary results

# GHG emissions and targets



Mt CO <sub>2</sub> e/y	1990	2008	2022
Rural land use	13.8	11.6	10.6
Scotland total	70.1	56.1	38.3

-1.0 Mt

# Tackling climate change in agriculture



## **Low Carbon Scotland: Meeting the Emissions Reduction Targets 2010-2022 - Report on Proposals and Policies (March 2011)**

Farming for a Better Climate

Scotland Rural Development Programme (SRDP)

Common Agricultural Policy (cross-compliance; post-2017)

# Mitigation options – which ones to choose?



## Economically efficient GHG reduction

- Many options targeting e.g. nutrient management, livestock efficiency, manure management – how to select the best ones?
- Compare their effectiveness: go for high GHG abatement and low cost



- MAC curve (Marginal Abatement Cost Curve)

# The MAC curve



## Key stages

1. Identifying possible mitigation options
  - Croplands, grasslands, livestock, land use change
  - Screening for feasible ones
2. Determining business as usual activities, emissions and farmers' profits
3. Quantifying cost-effectiveness (CE) of each measure
  - Estimating the abatement potential (AP)
  - Estimating the cost of each measure
4. Interaction of measures: adjusting AP and CE
5. Drawing the MAC curve

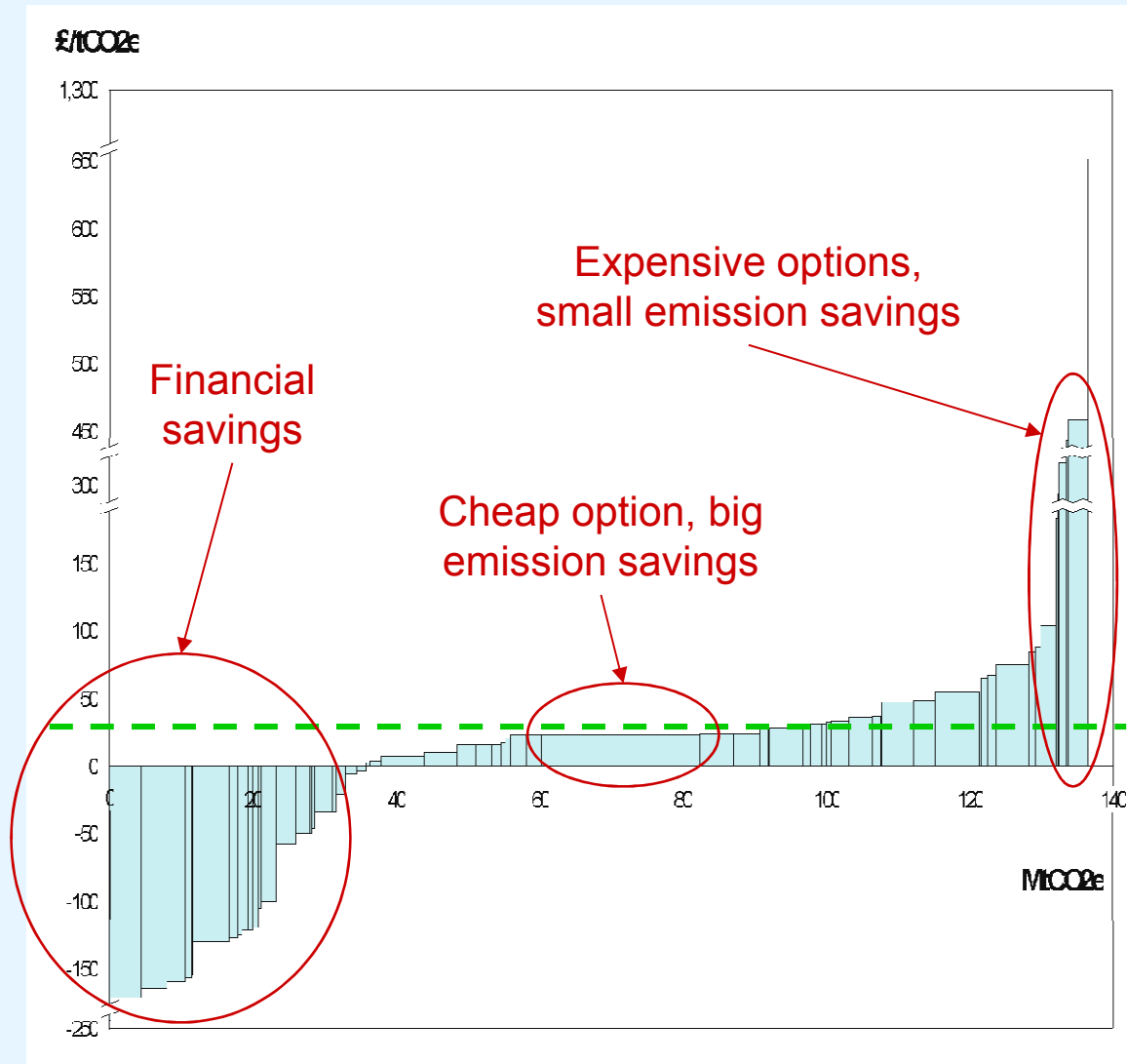
# A mitigation measure example



## Better timing of mineral fertilizer application

1. Applicability: 70% of arable land (of 0.494 M ha), 80% of grassland (of 1.242 M ha), 70% of other land (of 0.065 M ha) = 1.385 M ha
2. Abatement rate: 0.3 t CO<sub>2</sub>e/ha/y
3. Uptake rate (2022, maximum technical potential): 100%
4. **Total GHG abatement = 359 kt CO<sub>2</sub>e/y**
5. Cost: £ -31.01 /ha/y (based on farm model)
6. **Cost-effectiveness = £ -103 /tCO<sub>2</sub>e**

# What does a MAC curve tell us?



- Decreasing order of cost-effectiveness
- Width of bars: abatement potential
- Height of bars: cost-effectiveness

Cost of Carbon



# MACC (2008) and MACC Update (2010)



## **SAC MACC**

- relying highly on research results from Strategic Research Programmes 2006-2011

⇒ **CCC report 2008:** Building a low-carbon economy - the UK's contribution to tackling climate change

⇒ **CCC Scottish report 2010:** Scotland's path to a low-carbon economy

## **SAC MACC Update**

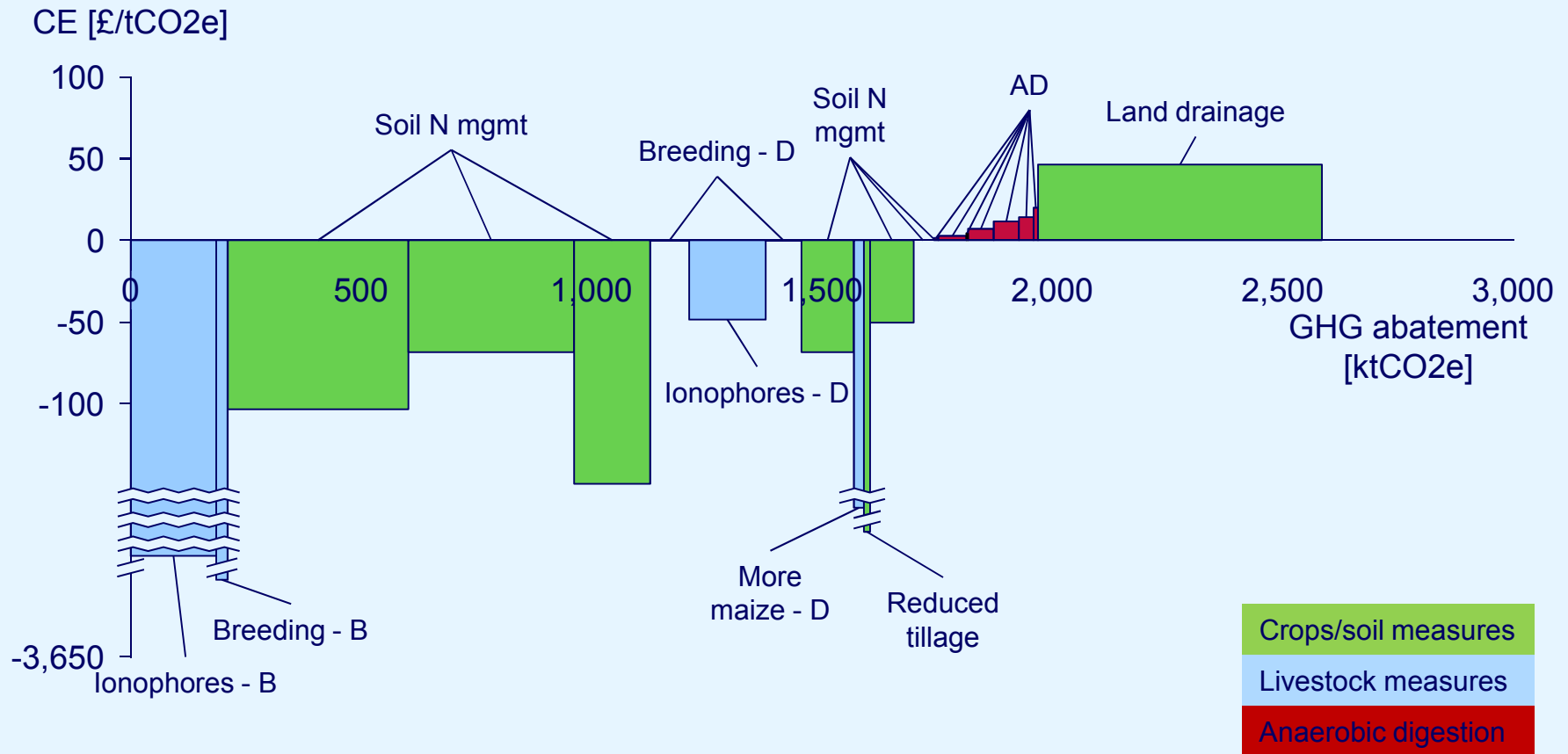
- addressing uncertainties, input from reviews, CCC, industry

⇒ **CCC report 2010:** The Fourth Carbon Budget - Reducing emissions through the 2020s

# MACC (2008)



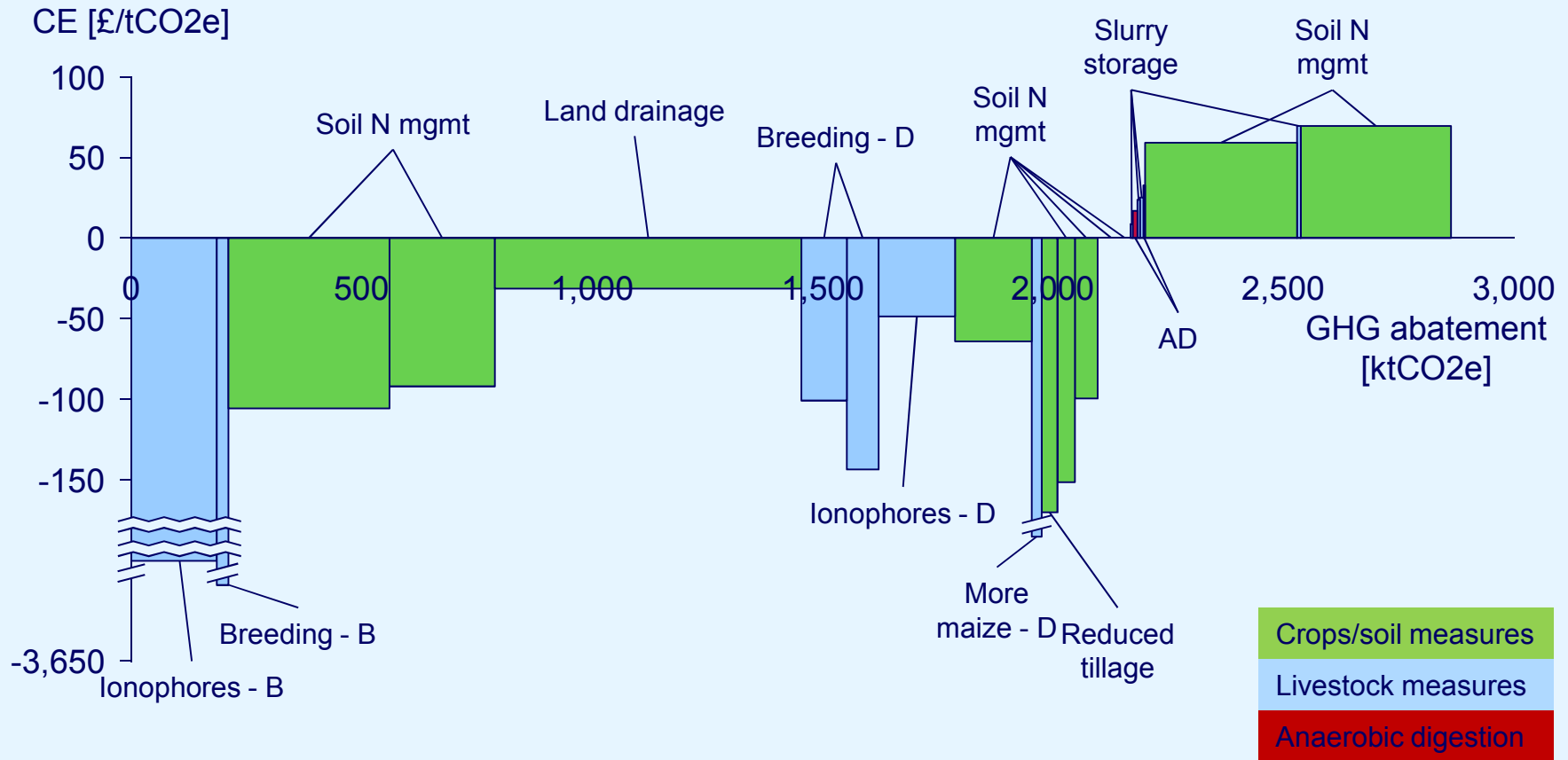
MACC for Scotland, 2022, maximum technical potential



# MACC Update (2010) - optimistic



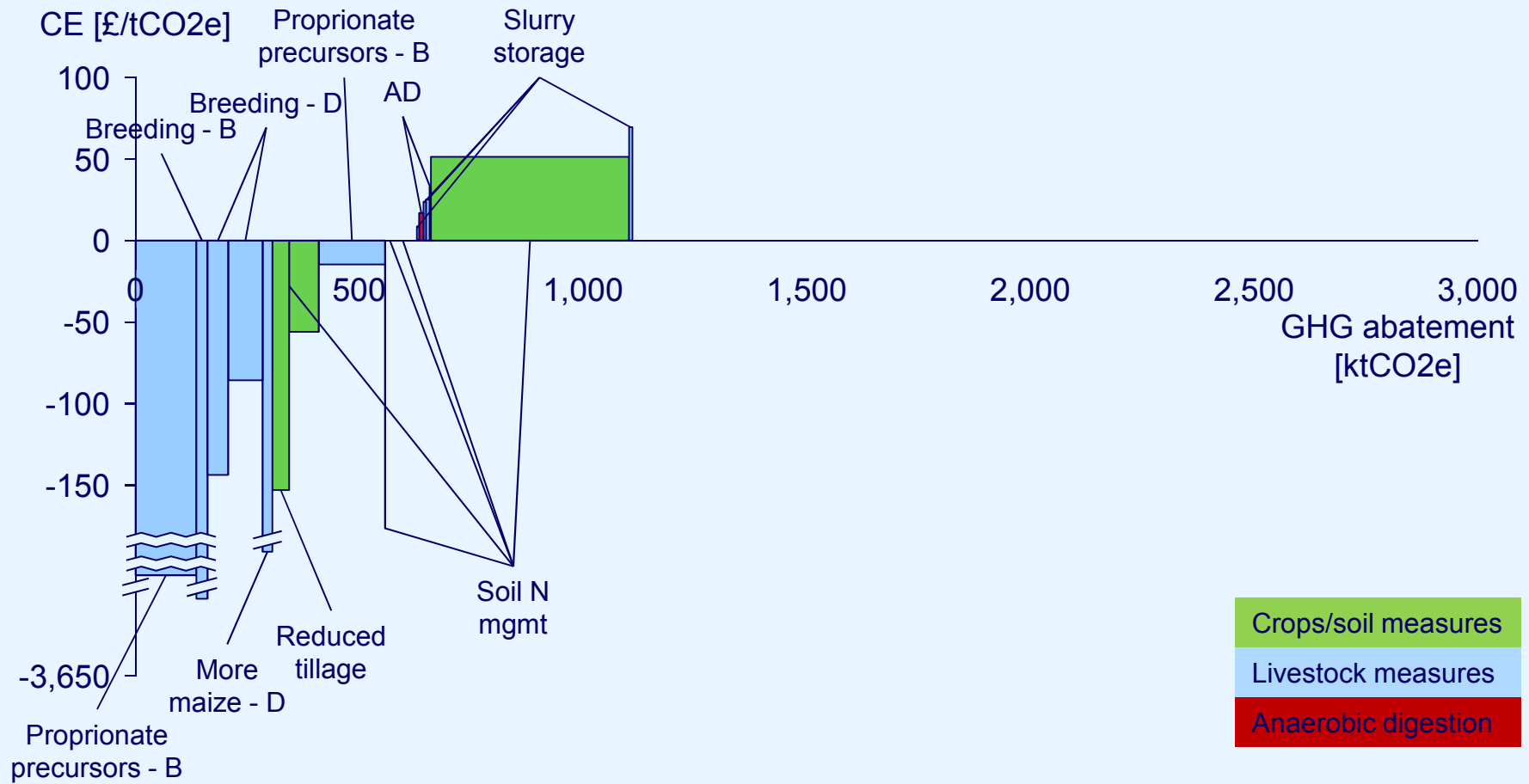
MACC for Scotland, 2022, maximum technical potential



# MACC Update (2010) - pessimistic



MACC for Scotland, 2022, maximum technical potential



## Key stages

1. Selecting mitigation measures (MMs) to be targeted
2. Assigning MMs to policies
3. Estimating uptake for each MM triggered by each policy (accounting for policy interactions)
4. Adding up MMs' GHG abatement and private cost (accounting for measure interactions)
5. Adding policy costs to private costs
6. Calculating cost-effectiveness for each policy  
 $CE = \text{costs} / \text{GHG abatement}$

# RPP1



Based on MACC (2008)

	FFBC	X-comp.	SRDP
CE (£/tCO <sub>2</sub> e)	-157	-98	24
GHG abatement in 2022 (ktCO <sub>2</sub> e)	326	540	18
Improved timing of mineral fertiliser application	✓	✓	
Improved timing of slurry and poultry manure application	✓	✓	
Full allowance on manure nitrogen supply	✓	✓	
Plant varieties with improved nitrogen use efficiency	✓		
Avoiding nitrogen excess	✓	✓	
Use composts, straw based manures in preference to slurry	✓		
Separate slurry applications from fertiliser appl. by several days	✓		
Improved genetic potential for beef cattle	✓		
Probiotics for beef	✓		
AD – Fattening pigs – large farms			✓
AD – Fattening pigs – medium farms			✓
AD – Beef cattle – large farms			✓
AD – Dairy cattle – large farms			✓
AD – Large poultry units			✓

# RPP2 – New values for MACC



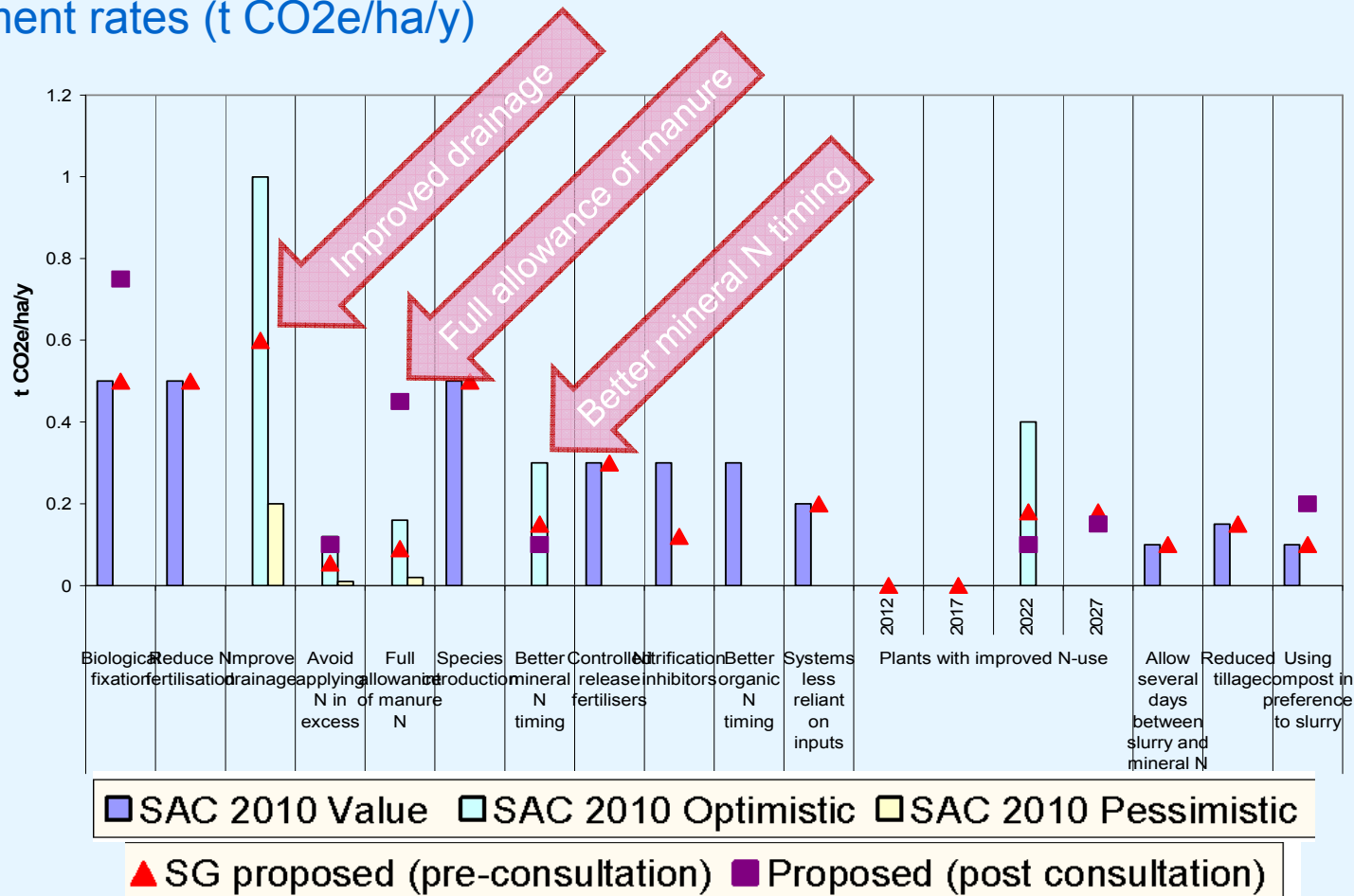
## Based on MACC Update (2010), updated with Scottish values:

- **Baseline activity data:** new FAPRI estimates instead of BAU3 estimates (FAPRI: slightly lower arable land area and livestock numbers, higher grassland areas)
- **Applicability rates and abatement rates:** refined to reflect Scottish circumstances by RESAS and Agriculture and Climate Change Stakeholder Group
- **Policy assumptions:** to be refined by RESAS

# RPP2 – Consultation



Agriculture and Climate Change Stakeholder Group consultation – example: abatement rates (t CO<sub>2</sub>e/ha/y)



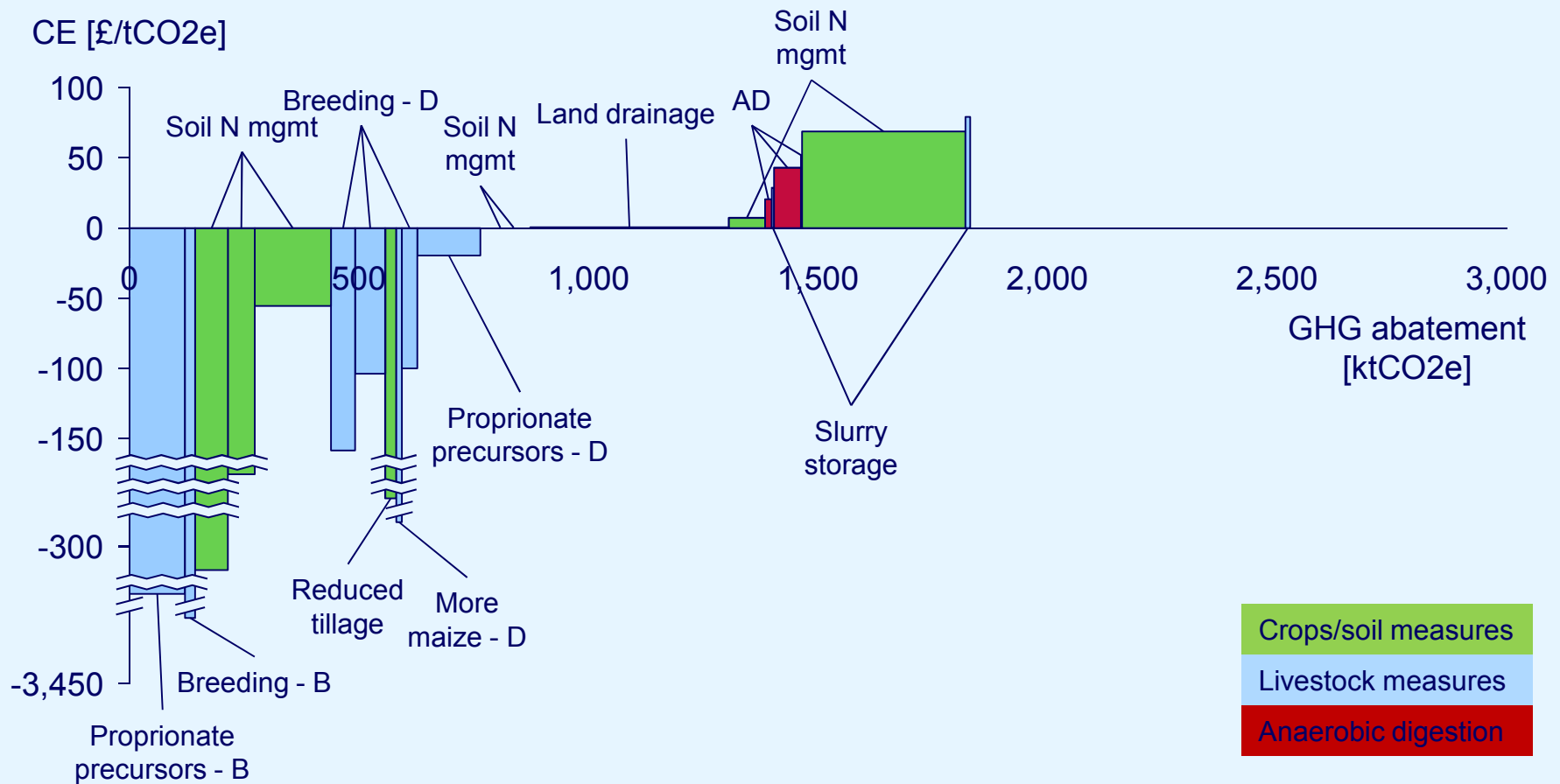
7/10/2011



# RPP2 – MACC 2011



## MACC for Scotland, 2022, maximum technical potential



# RPP2 – Changes in the MACC



## **Main changes in the MACC relevant to RPP:**

- Better timing of mineral nitrogen: abatement rate reduced to 1/3 of original value by SG-ACCSG
- Better timing of organic nitrogen: applicability rates reduced to 1/2-1/3 of original value in MACC Update (2010)
- Avoid applying nitrogen in excess, Full allowance of manure N supply, Plants with improved nitrogen-use efficiency: either applicability or abatement rates reduced, either in MACC Update (2010) or by SG-ACCSG

## **Minor changes relevant to RPP:**

- Separate slurry applications from fertiliser applications by several days, Reduced tillage, Use composts in preference to slurry: increase in GHG abatement, but low total abatement
- Dairy/Beef AD: reduction in GHG abatement, but low total abatement

# RPP2 – Work in progress



Based on the new Scottish MACC (2011), RPP1 policy mix

	FFBC	X-comp.	SRDP
CE (£/tCO <sub>2</sub> e)	-201	-96	72
GHG abatement in 2022 (ktCO <sub>2</sub> e)	169	192	10
Improved timing of mineral fertiliser application	✓	✓	
Improved timing of slurry and poultry manure application	✓	✓	
Full allowance on manure nitrogen supply	✓	✓	
Plant varieties with improved nitrogen use efficiency	✓		
Avoiding nitrogen excess	✓	✓	
Use composts, straw based manures in preference to slurry	✓		
Separate slurry applications from fertiliser appl. by several days	✓		
Improved genetic potential for beef cattle	✓		
Probiotics for beef	✓		
AD – Fattening pigs – large farms			✓
AD – Fattening pigs – medium farms			✓
AD – Beef cattle – large farms			✓
AD – Dairy cattle – large farms			✓
AD – Large poultry units			✓

Policy mix to be changed by SG

# Acknowledgements



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