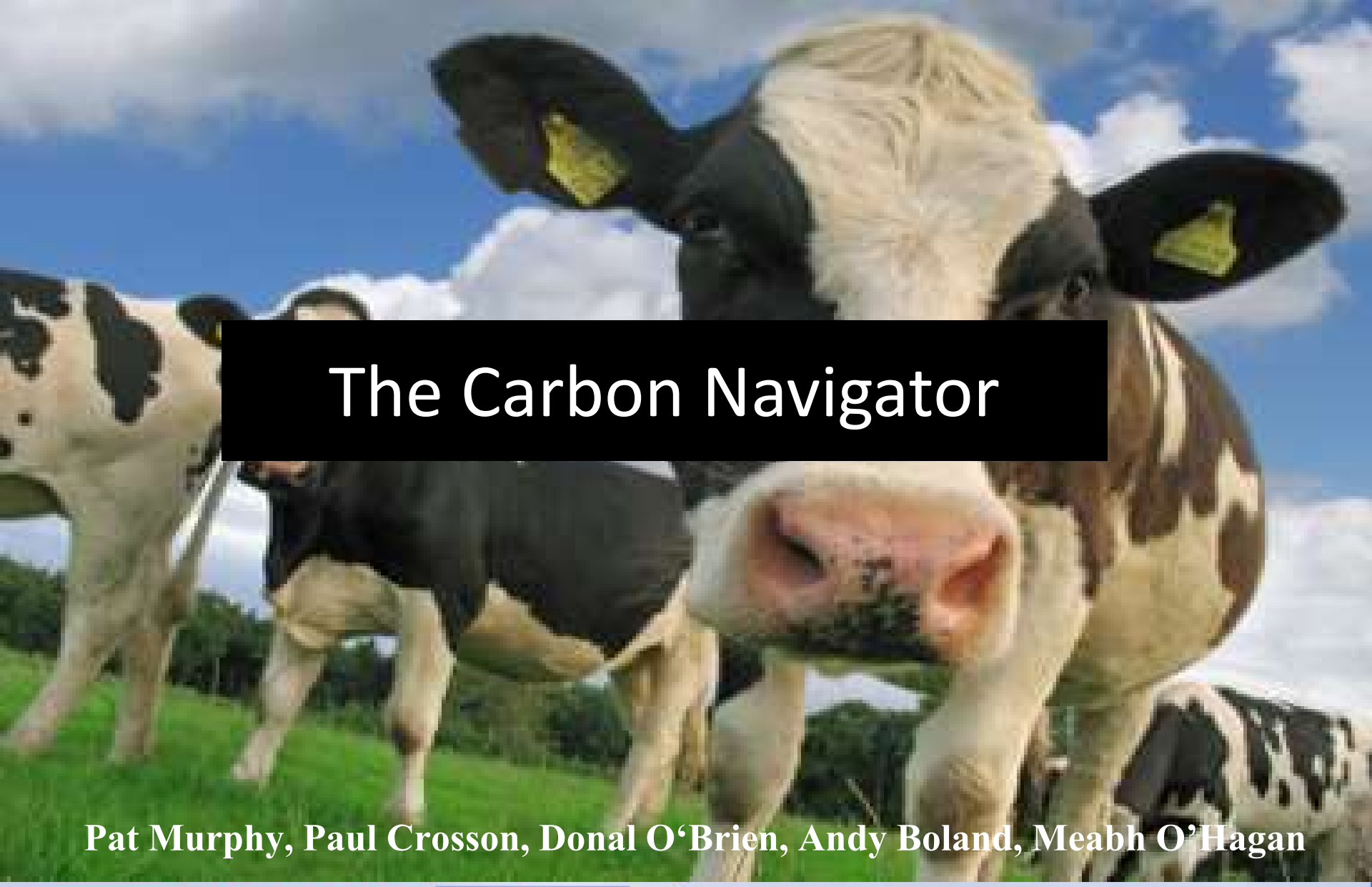

The Carbon Navigator

Pat Murphy, Paul Crosson, Donal O'Brien, Andy Boland, Meabh O'Hagan

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The European Agricultural Fund for Rural Development: Europe investing in rural areas

Department of Agriculture, Food and the Marine
An Roinn Talmhaíochta, Bia agus Mara

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Course outline

- Introduction to the Carbon Navigator
- Mitigation Options in the Carbon Navigator
- Using the Carbon Navigator – Demonstration
- Case Studies
- Getting Set-up

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Introduction - The Carbon Navigator

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The objective of the project

- To raise awareness amongst professionals
- To put GHG mitigation on farmer's agenda
- To provide a pathway for improved carbon efficiency and profitability
- To support the marketing of Irish dairy and beef produce

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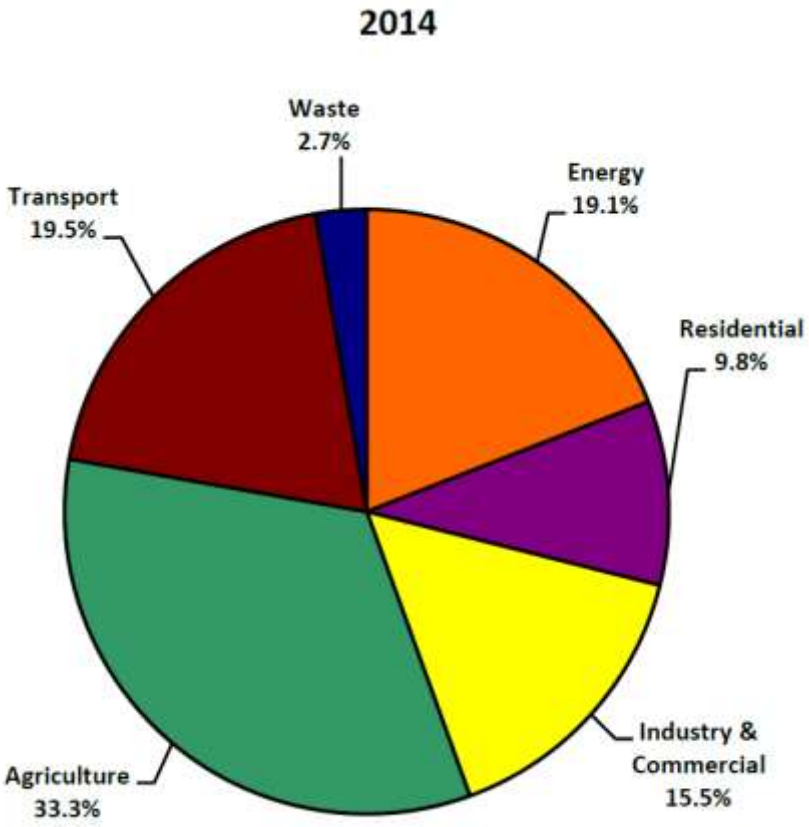
Key Facts

- Agriculture 33% of total Irish GHG emissions
- High proportion in Ireland (EU Average 9%)
- Difficult to mitigate
- Different gases from other sectors
  - Mostly non-CO_2 gases in agriculture
  - Methane (CH_4)
  - Nitrous oxide (N_2O)



EPA, 2015

Agricultural GHGs

Main agricultural GHGs	kg CO_2 equivalents per kg	% Of Irish agricultural GHGs
Carbon Dioxide (CO_2)	1	3%
Methane (CH_4)	25	63%
Nitrous Oxide (N_2O)	296	34%

Where GHGs come from

Methane (63%)

Enteric Fermentation

51 %

Manure

12%

Nitrous Oxide (34%)

Excreted N Urine & Dung

15%

Fertilizer Chemical & Organic Application and Storage

19%

Where GHGs come from

Sources of Greenhouse Gasses on the Farm

Methane 63%

Nitrous Oxide 34%

Carbon Dioxide 3%

What is Carbon Footprint?

- The quantity of GHG emissions generated in the production of a product or service
- Measured in CO_2 equivalents per Kg output
- For livestock production:
  - [Methane + Nitrous Oxide + CO_2] / Output of milk or meat
    - Dairy ~ 1 kg CO_2 eq/ kg milk
    - Beef ~ 18 kg CO_2 eq/ kg carcass
- Allows for comparison – regions, systems, food products

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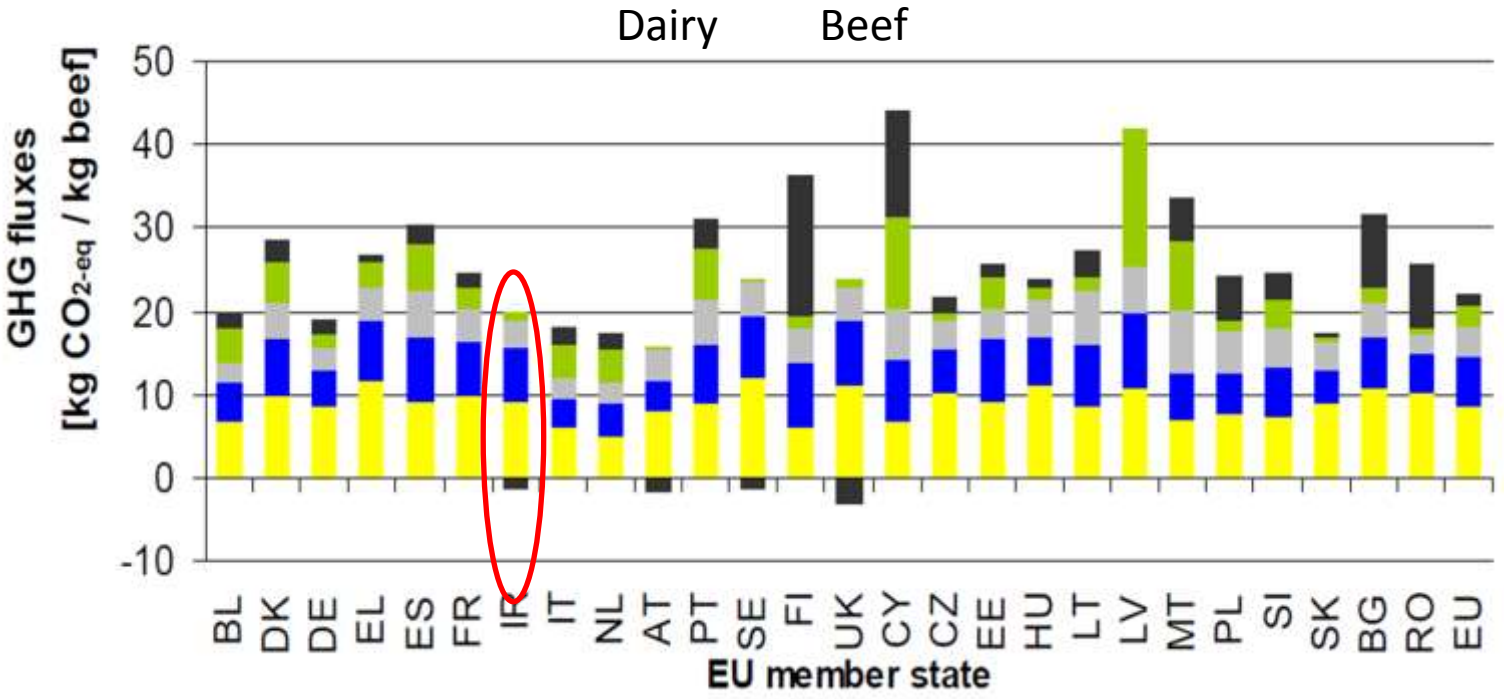
Ireland's comparative advantage

Good starting point…

- Lowest carbon footprint of milk in EU
- Fifth lowest carbon footprint of beef in EU
- Efficient on a global basis



Ireland's Challenges – Emissions Targets

Current Targets – EU

- 20% reduction by 2020

Recent Agreement… EU target

- 40% reduction by 2030
- Agriculture considered in national targets
- Broadening scope of agriculture – forestry and land use
- Financial penalties if miss targets, billions of euros if Ireland fails to achieve targets

Long Term Objective

- 80% reduction by 2050

Ireland's Challenges – Emissions Targets

COP 21

- Ireland can expect to be assigned increasingly strict targets to cut its emissions, one third of which come from agriculture.
- Agriculture will not be exempt, but all countries will report it in the same way and fair comparisons will become possible
- Recognises "the fundamental priority of safeguarding food security and ending hunger" and on the impacts of climate change
- Emphasised the role of actions to conserve and enhance "sinks"

Ireland's Challenges

Agriculture to Play its Part

- Difficult to Mitigate
- Growth under Food Harvest and Food Wise will push up emissions
- Ireland – a sustainable food producer → market access and price

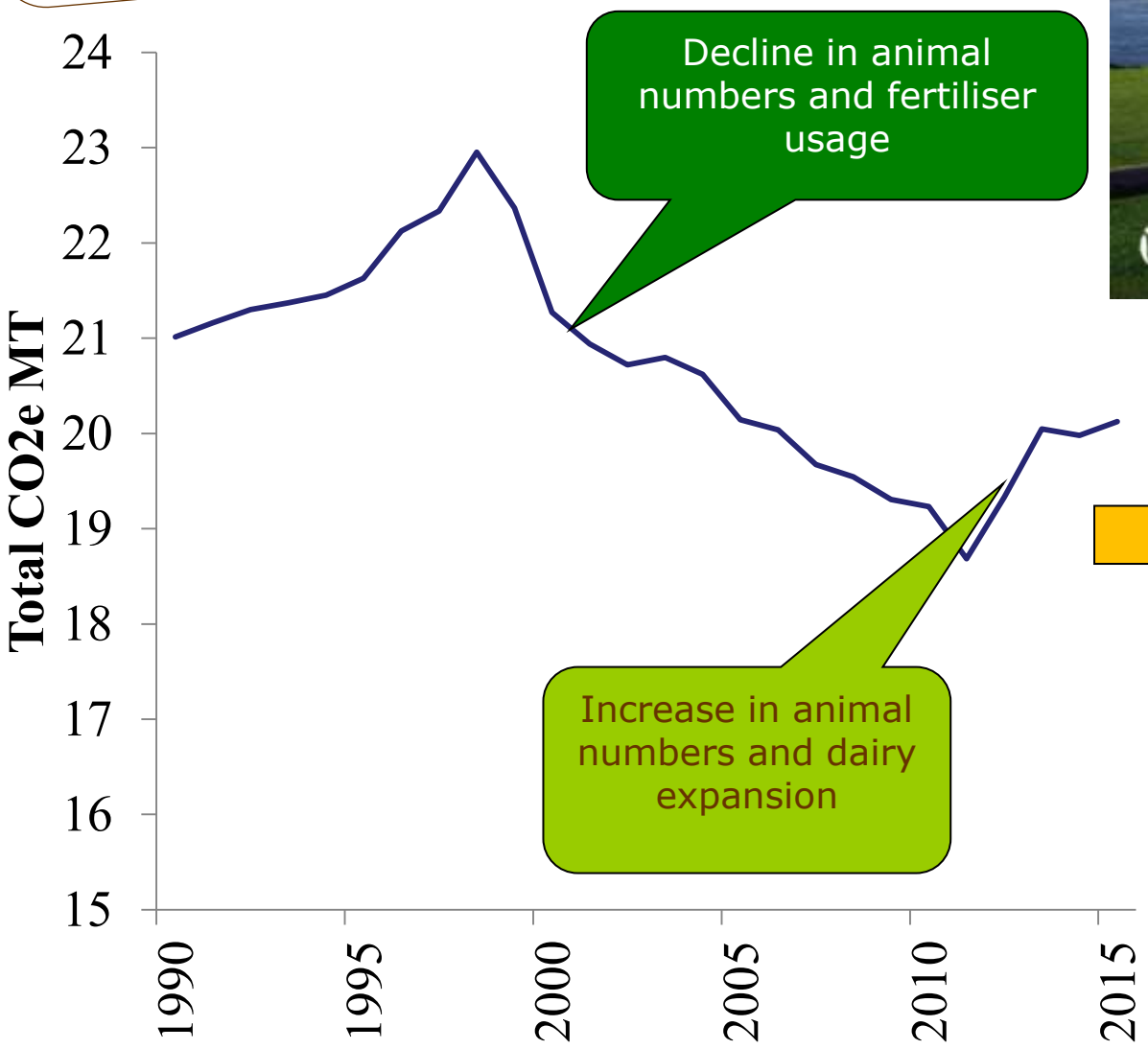
Global situation

- Growing population & Growing urbanisation
- Increasing demand for protein food products – must be efficiently produced

Challenge for Ireland –

To produce the most carbon efficient Dairy and Beef products

Ireland's Challenges



"environmental protection and economic competiveness will be considered as equal and complementary"

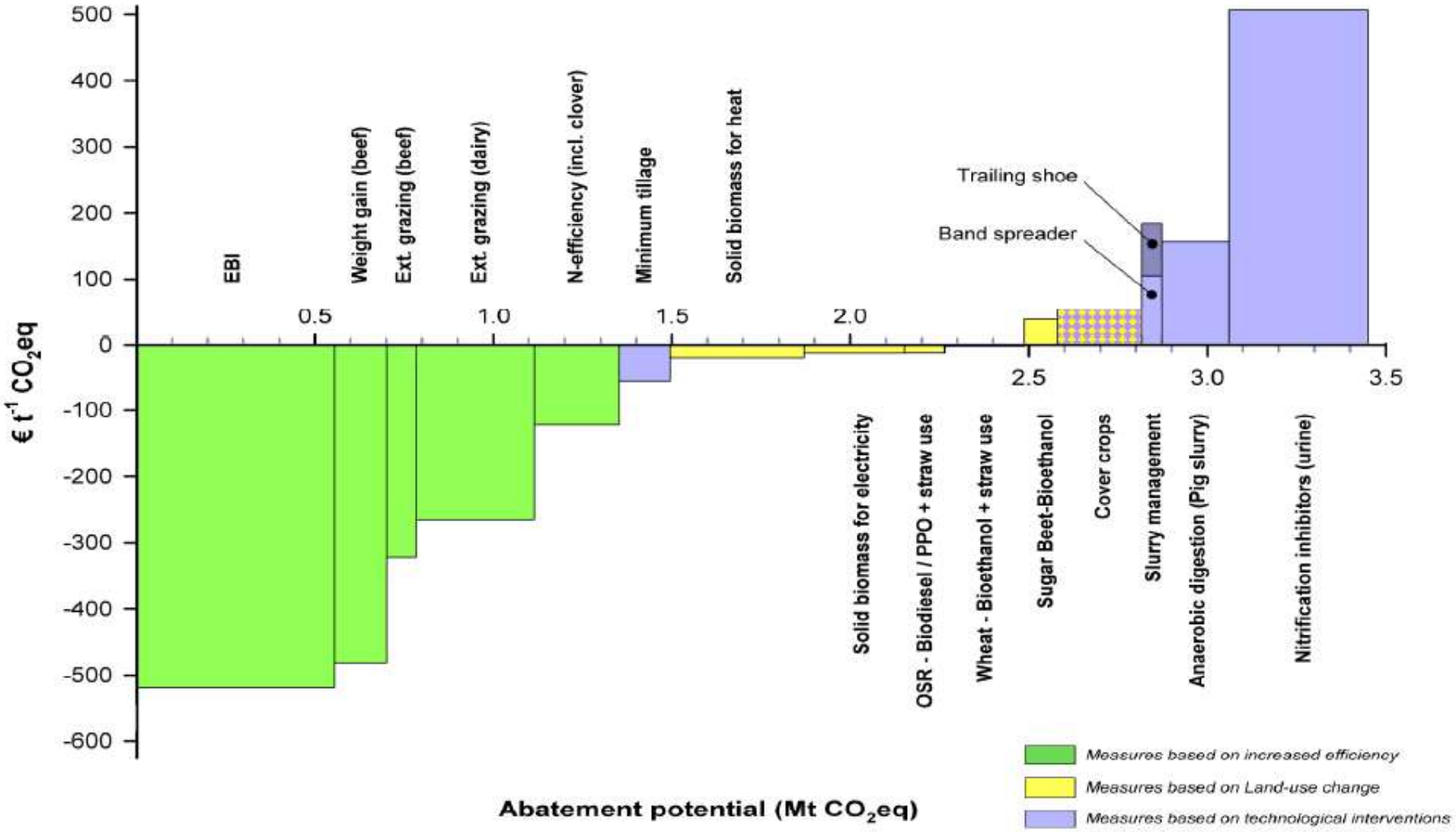
WIN –WIN s for GHG reduction

Different forms of actions

- Efficiency - More output per unit of input
  - Increased yields – Meat and milk
  - Lowering unproductive parts of cycle
  - Lowering losses from fertilisers and manures
- Land use Change
  - Energy Crops, Forestry
  - Managing for sequestration (Reseeding methodology)
- Use of Technologies
  - Trailing shoe, Inhibitors

WIN–WINs – Reduced Emissions at the same time as increased farmer profit

Marginal Abatement Cost Curve (LCA)



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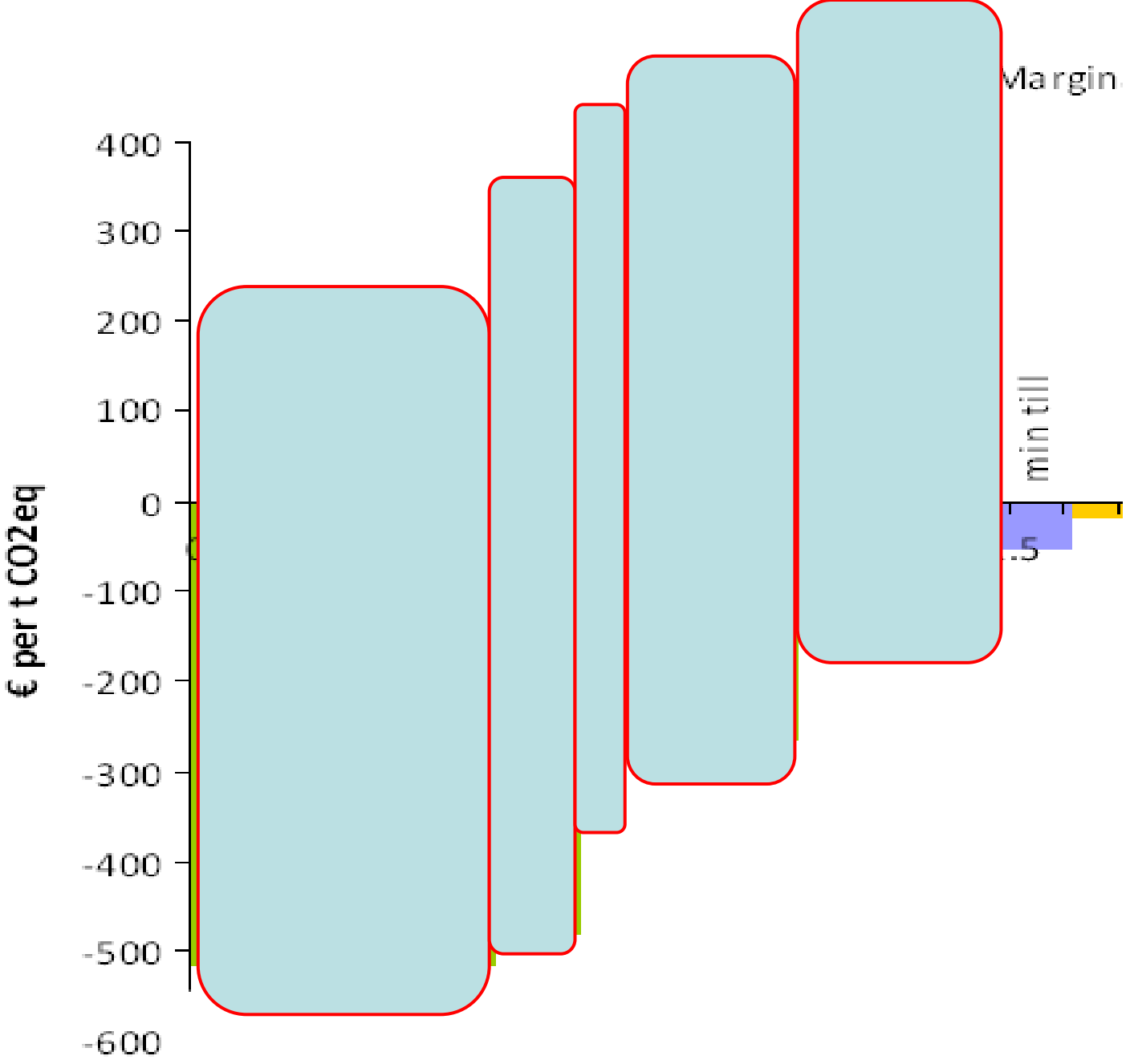
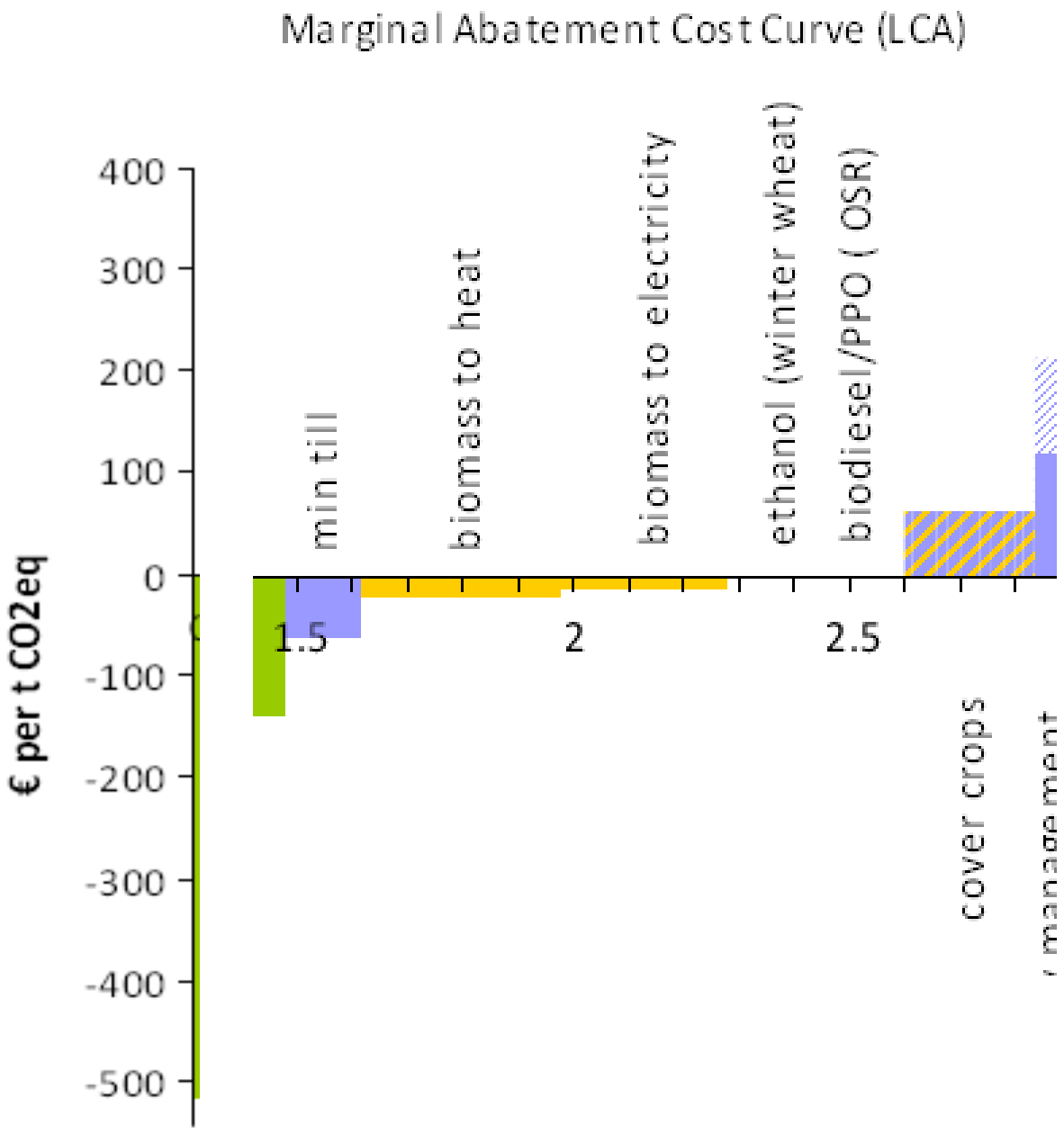
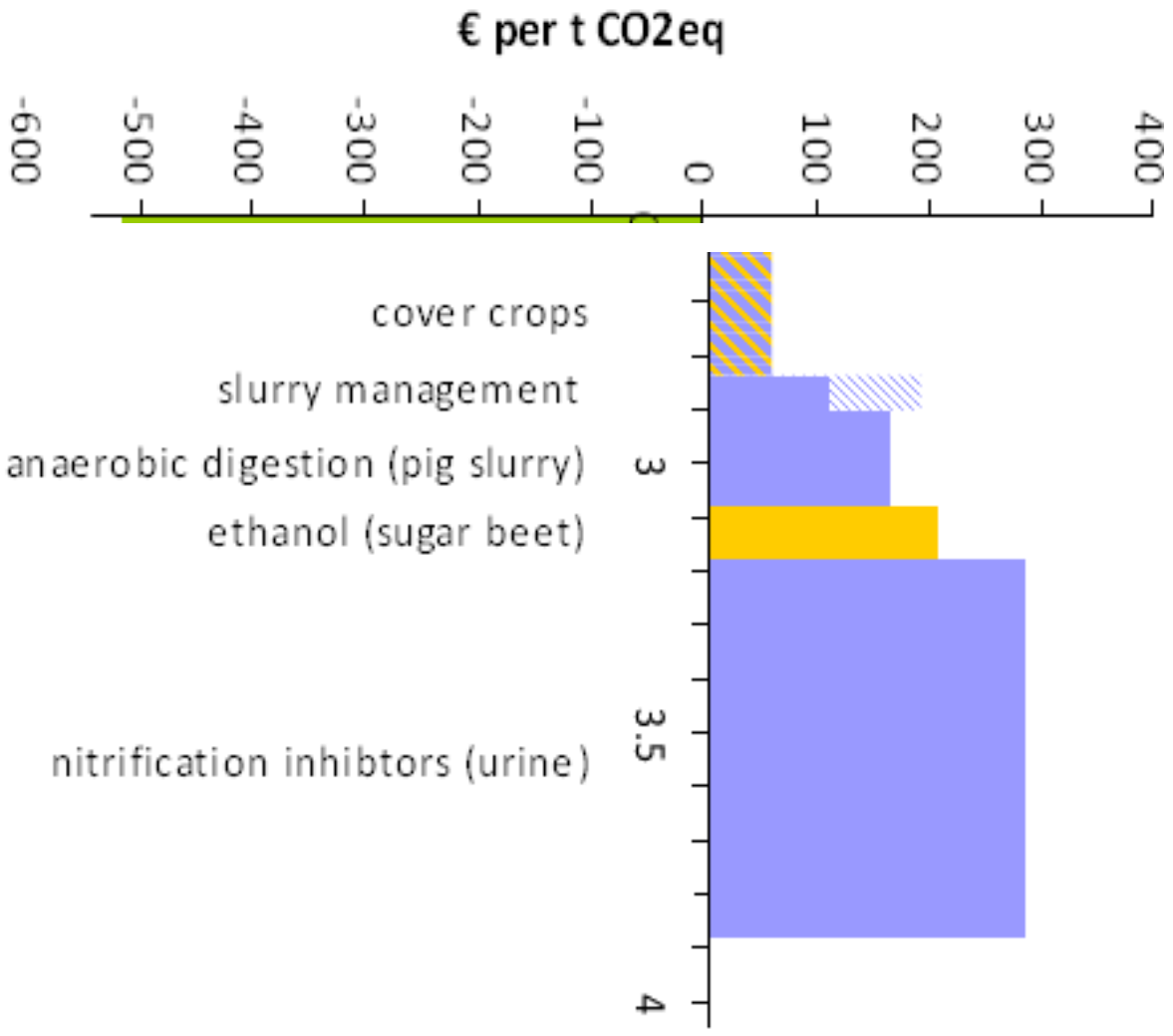
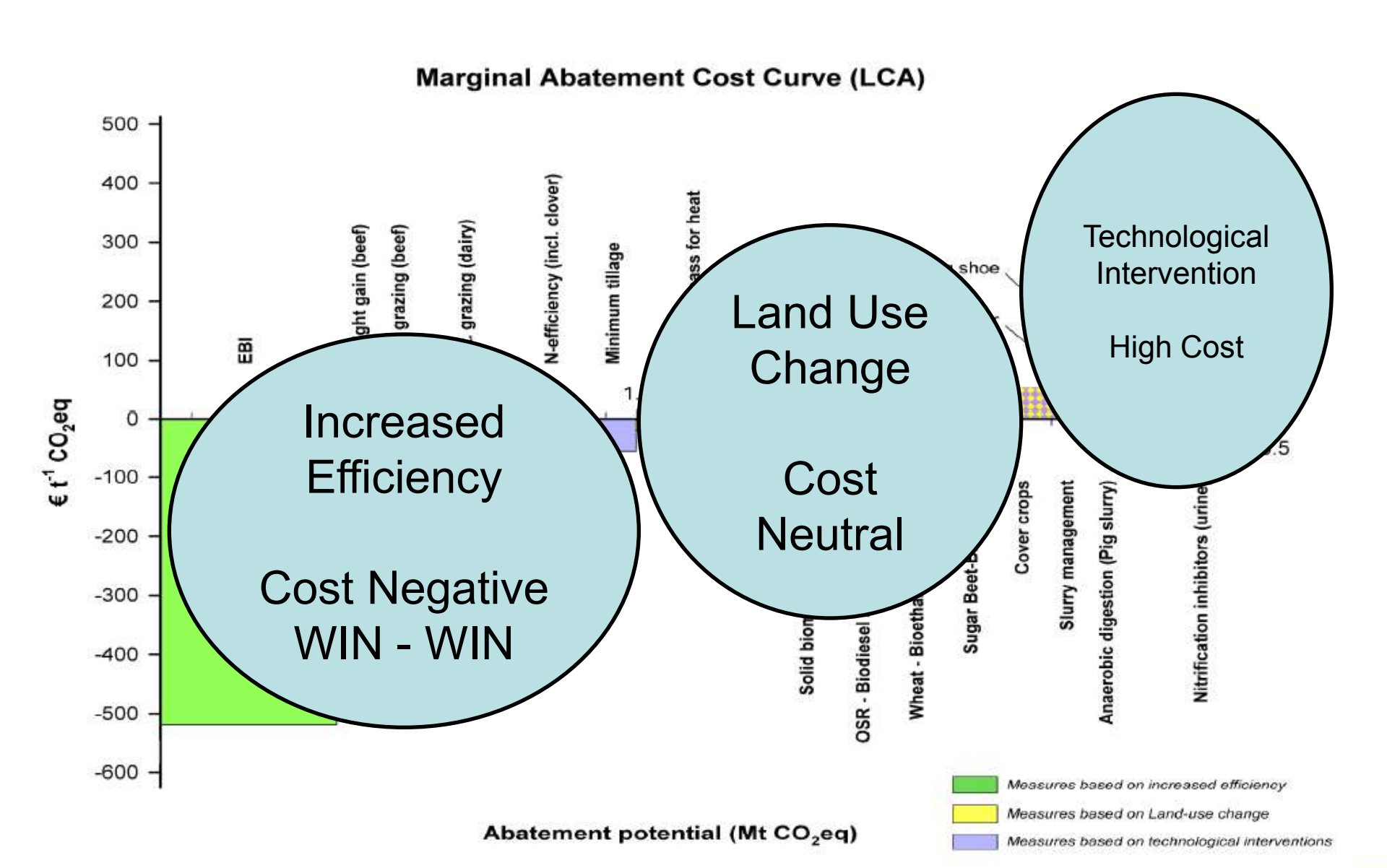

Margin
400
300
200
100
0
-100
-200
-300
-400
-500
-600
€ per t CO2eq
min till
-5


Marginal Abatement Cost Curve (LCA)
€ per t CO2eq
400
300
200
100
0
-100
-200
-300
-400
-500
1.5
2
2.5
min till
biomass to heat
biomass to electricity
ethanol (winter wheat)
biodiesel/PPO (OSR)
cover crops


€ per t CO2eq
-600
-500
-400
-300
-200
-100
0
100
200
300
400
cover crops
slurry management
anaerobic digestion (pig slurry)
ethanol (sugar beet)
nitrification inhibtors (urine)
3
3.5
4



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The Carbon Navigator: What does it do

- Farmer works with his adviser / consultant
  - Assess level of adoption / performance in relation to mitigating technologies
  - Compares with average and top farmers
  - Identify potential for improvement
  - Set Targets

The Carbon Navigator: What it doesn't do

- The Navigator does not quantify Carbon Footprint of farms
  - Why?
- Globally greater focus on cutting instead of counting footprint
- Difficult to accurately quantify Carbon Footprint
  - Need large amounts of information – Regular farm audits
  - Requires certification and verification

Dairy Measures

Pat Murphy, Paul Crosson, Donal O'Brien, Andy Boland, Meabh O'Hagan

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Dairy Farms – How can we reduce Agricultural GHGs

Better slurry and fertiliser management

Longer Grazing season

Improved Genetics - EBI

Increased N Efficiency

Improved Energy Efficiency

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Measure : extended grazing season

- Lower quantity of slurry stored
- Lower ruminant digestion emissions – higher digestibility diet
  - Grass v Silage
- Lower energy (fuel) emissions
- Higher milk solids – Improved protein content

Measure : EBI

- Improving fertility: - Fewer replacements and higher pregnancy rates.
- Earlier compact calving - Greater proportion of grazed grass in the diet
- Higher milk solids yield per unit of grazed grass
- Improved health reduces deaths and disease

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Measure : nitrogen efficiency

- 15 – 20% of total systems emissions
- Improved N utilisation → lower losses as N2O and ammonia gas
- Affected by spreading dates, rate of N and soil fertility
- Use of Urea preferred → lower GHGs to produce and at application than CAN
- Better grassland management and utilisation
- Incorporation of clover into grazing swards

Measure : Slurry management

- Spring application reduces ammonia emissions due to more favourable cooler weather conditions
- Storage losses are also reduced due to the shorter storage period
- Low emissions application technologies e.g. trailing shoe
  - Reduced ammonia losses
  - Greater fertiliser replacement value of slurry

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Measure : Energy Efficiency

Electricity consumption ranged from 53 to 108 Watts per litre

- Small contribution relative to others
- Electricity cost per litre vary from 0.23 to 0.76 cent.
- Three key areas to reduce energy costs and related emissions.
  - Effective pre-cooling in a Plate Heat Exchanger
  - Variable Speed Drive (VSD) Vacuum Pumps (Bigger Units)
  - Energy efficient water heating systems.

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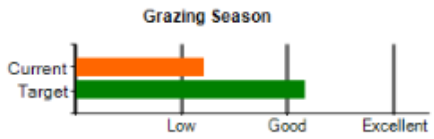
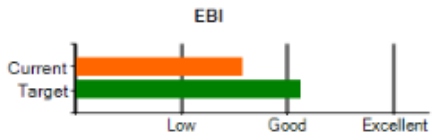
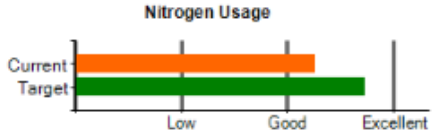
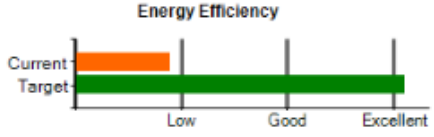
Farmer Name	Pat Murphy	Average number of dairy cows	100
County	Kilkenny North	Average number of cows planned (3 years)	130
Soil Type	Moderately Drained	Livestock Units Other Stock	60
Area farmed (ha)	85	Livestock Units Other Stock (3 years)	30
Plan Year	2014		

Potential impact of meeting all targets

-12.9% +€10957

Year 2014		Current	Target	Chart	GHG change	€ benefit
Grazing season length	Turnout Date - Part Time	10/Mar	01/Mar		-2.9%	+€4590
	Turnout Date - Full Time	20/Mar	15/Mar			
	Housing Date - Part Time	01/Nov	07/Nov			
	Housing Date - Full Time	01/Nov	15/Nov			
EBI	EBI	85	115		-6.0%	+€3900
Nitrogen Efficiency	Stocking rate (Kg N / Ha grass)	160.00	160.00		-1.7%	+€1045
	Chemical N used (Kg N / per Ha) : Urea	20.00	50.00			
	Ammonium N	140.00	110.00			
	Import (+) or Export of Org Manure N/Ha					
	Meal keeding Kg / Cow	600.00	600.00			
	Milk output / cow (Kg milk solids)	400.00	420.00			
Slurry Spread Timing	% in Spring	40	60		-1.2%	+€154
	% Summer following 1st cut	60	40			
	% Later in Summer	0	0			
	Application Method	Splash Plate	Splash Plate			
Energy Efficiency	Plate Cooler Present	☑	☑		-1.0%	+€1268
	Average Temperature of Milk after Plate Cooler	20.0	14.0			
	Variable Speed Vacuum Pump	☐	☑			
	Method of Water Heating	Electricity	Oil			

Update

Beef Measures

Pat Murphy, Paul Crosson, Donal O'Brien, Andy Boland

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Beef Farms – How can we reduce agricultural GHGs

Longer grazing seasons

Earlier first calving

Improved calving rate

Better liveweight performance

Better slurry management

Nitrogen Efficiency

Measure: extended grazing season

- Lower quantity of slurry stored
- Lower ruminant digestion emissions due to higher digestibility diet
- Lower energy (fuel) emissions
- Also improves liveweight performance

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Measure: age at first calving

Animal producing methane for longer before first calving

- Increased GHG emissions during rearing phase
- Target 24 months of age
- Current average ~30 months of age

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Measure: calving rate

- The number of calves produced per cow on the farm each year
- Target for each cow to produce one calf every year
- Current national average calving rate ~0.83 calves/cow/year
  - So GHG emissions of every 100 cows "covered" by only 83 calves → increases carbon footprint

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Measure : Improved liveweight performance

- GHG emissions "covered" by higher levels of beef output
- Shorter lifetime to slaughter – less emissions generated
- Liveweight performance often difficult to quantify
  - Use best data available – mart, factory and ICBF records preferred (otherwise use estimated age/weight at sale)
  - Focus on improving performance

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Measure : nitrogen efficiency

- 15 – 20% of total systems emissions
- Improved N utilisation → lower losses as N2O and ammonia gas
- Affected by spreading dates, rate of N and soil fertility
- Use of Urea preferred → lower GHGs to produce and at application than CAN
- Better grassland management and utilisation
- Incorporation of clover into grazing swards

Measure : Slurry management

Slurry management accounts for ~10-15% of total system

- Spring application:
  - reduces (1) ammonia emissions due to damp/misty weather conditions and (2) storage losses
- Low emissions application technologies reduce ammonia losses
- Lower ammonia losses increases the fertiliser replacement value of slurry → lower N fertiliser requirements

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Bord Bia Teagasc Carbon Navigator

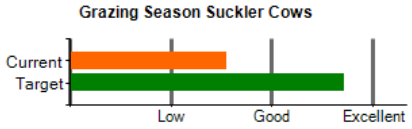
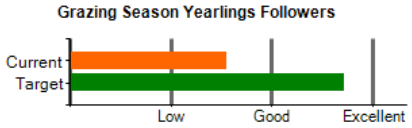
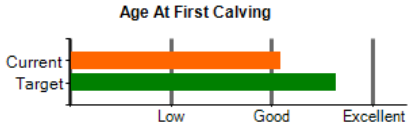
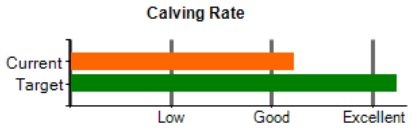
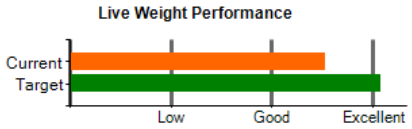
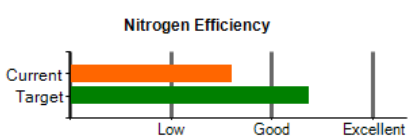
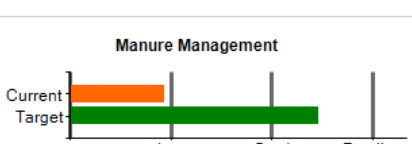
This facility will apply Farm Enterprise Information collected at the last audit to the Carbon Navi

Herd B1111199 *

Update | Download Excel File

Potential impact of meeting all targets

-20.0% +€13445

Year 2010		Current	Target	Chart	GHG change	€ benefit
Grazing season - suckler cows	Turnout Date	24/Mar	10/Mar		-2.5%	+€1509
	Housing Date	01/Nov	15/Nov			
Grazing season - yearlings/followers	Turnout Date	24/Mar	10/Mar		-1.9%	+€2208
	Housing Date	01/Nov	15/Nov			
Age at first calving	Age at first calving (months)	30.2	28.0		-0.7%	+€773
Calving Rate	Calving rate (calves/cow)	0.8	0.9		-8.3%	+€3010
Live weight performance	System	Steers & Heifers	Steers & Heifers		-0.4%	+€4497
	Lifetime live weight per day of age (g)	860.00	946.0			
Nitrogen Efficiency	Total CAN and equivalent N in Compounds (t)	18.0	7.0		-1.9%	+€1300
	Total urea used (t)	0.0	5.0			
	Total concentrate fed (t)	12.0	12.0			
	Output kg beef live / ha	473.8	500.0			
Slurry Spread Timing	% in Spring	30	70		-4.3%	+€148
	% Summer following 1st cut	30	30			
	% Later in Summer	40	0			
	Application Method	Splash Plate	Splash Plate			

Update