



The Carbon Navigator

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

Course outline

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



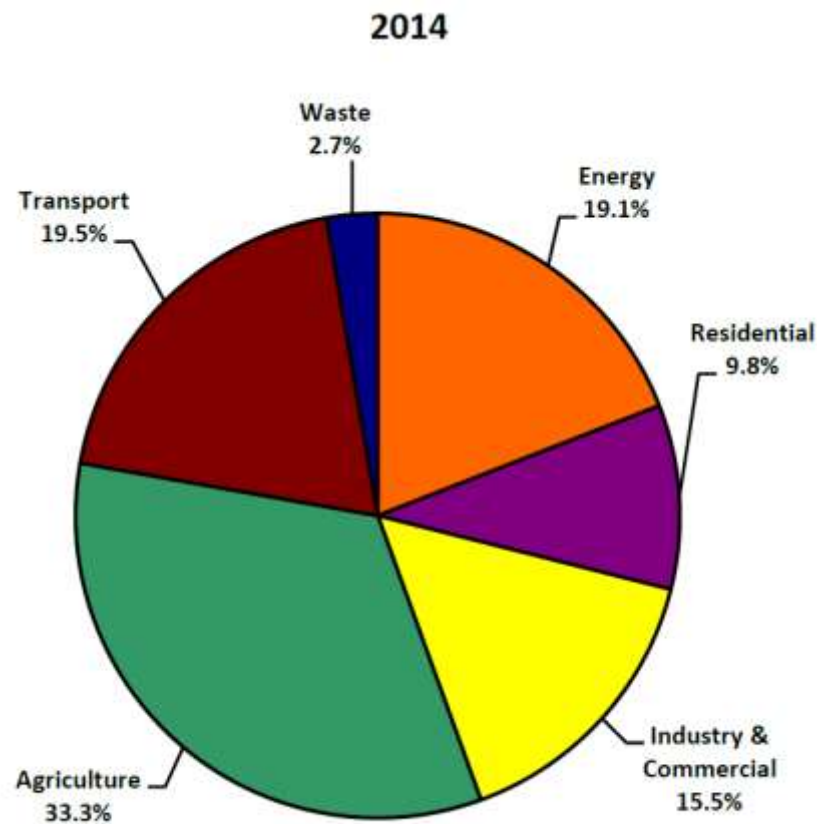
Introduction - The Carbon Navigator

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

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-CO₂ gases in agriculture
 - ❑ Methane (CH₄)
 - ❑ Nitrous oxide (N₂O)



EPA, 2015

Agricultural GHGs

Main agricultural GHGs	kg CO₂ equivalents per kg	% Of Irish agricultural GHGs
Carbon Dioxide (CO ₂)	1	3%
Methane (CH ₄)	25	63%
Nitrous Oxide (N ₂ O)	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%



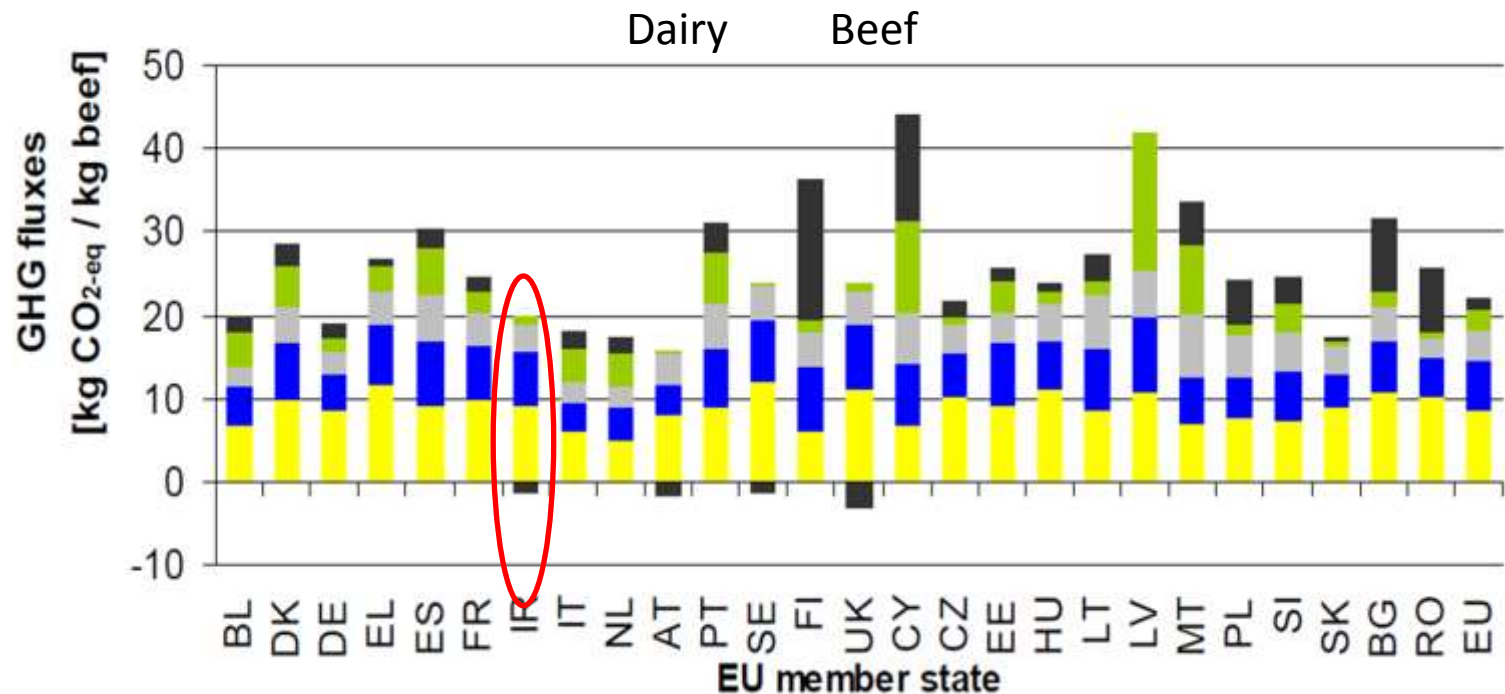
What is Carbon Footprint?

- ❑ The quantity of GHG emissions generated in the production of a product or service
- ❑ Measured in CO₂ equivalents per Kg output
- ❑ For livestock production:
 - ❑ $[\text{Methane} + \text{Nitrous Oxide} + \text{CO}_2] / \text{Output of milk or meat}$
 - ❑ Dairy ~ 1 kg CO₂ eq/ kg milk
 - ❑ Beef ~ 18 kg CO₂ eq/ kg carcass
- ❑ Allows for comparison – regions, systems, food products

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

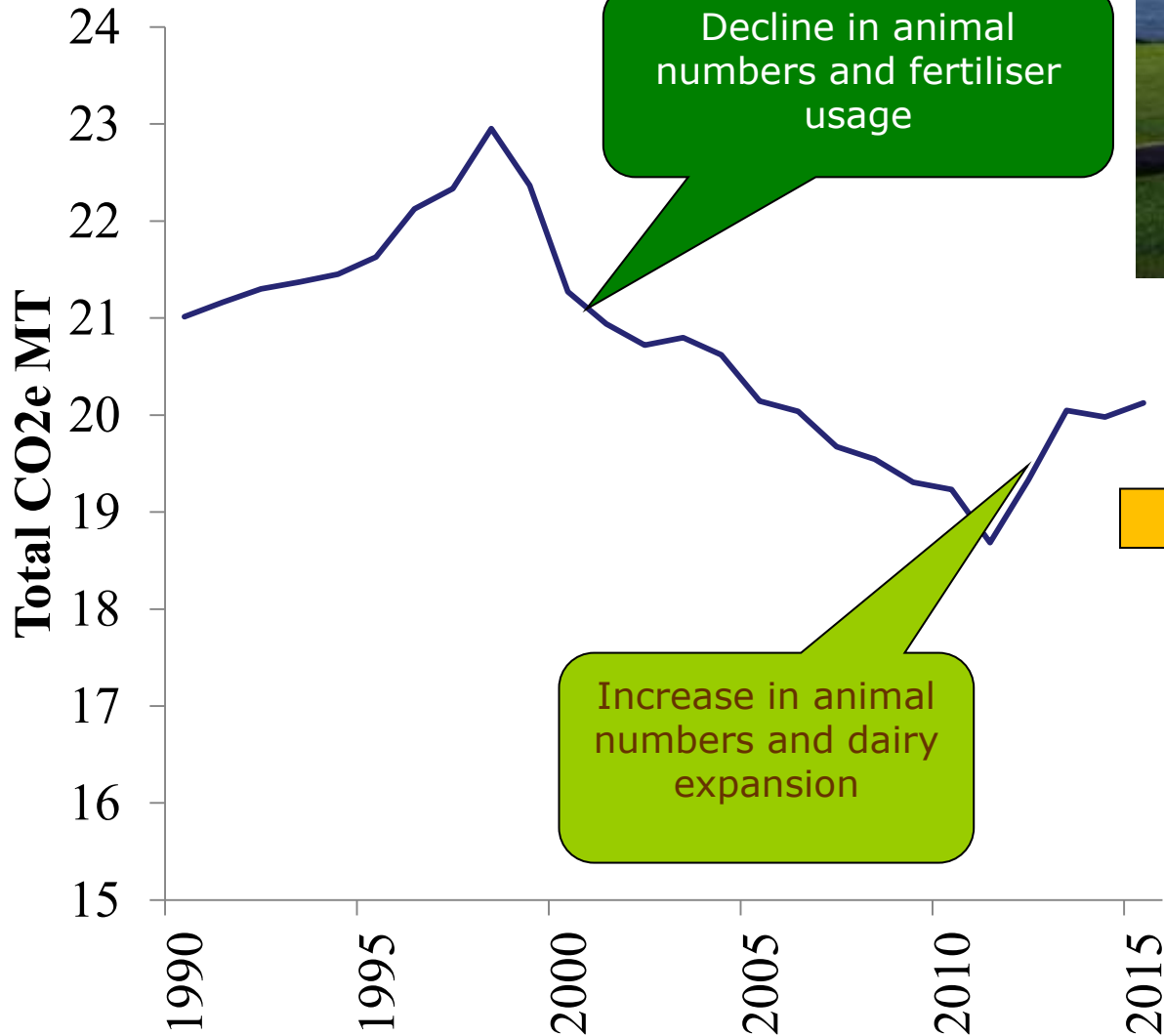
Global situation

- ❑ 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 competitiveness will be considered as equal and complementary”

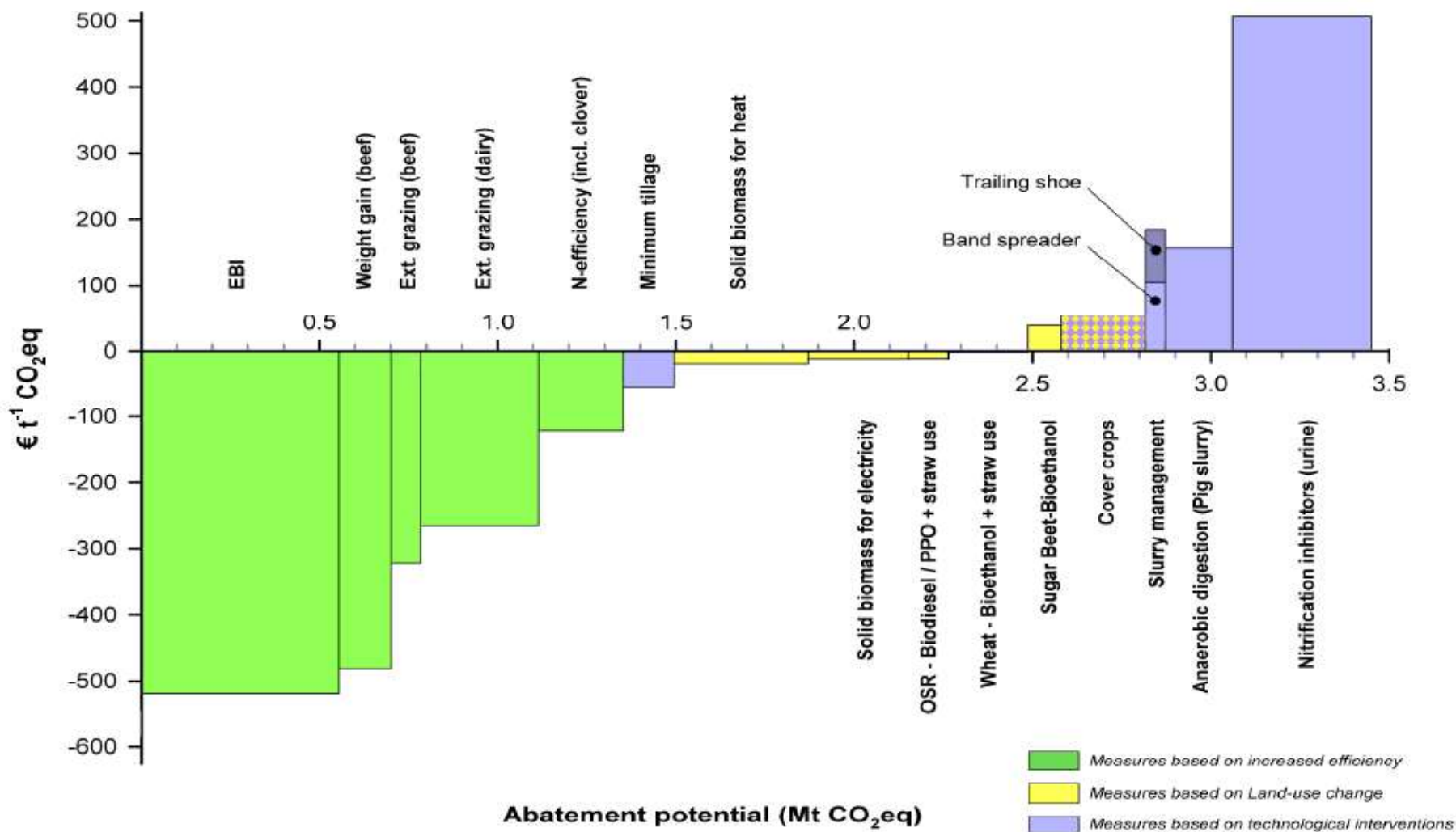
WIN –WIN s for GHG reduction

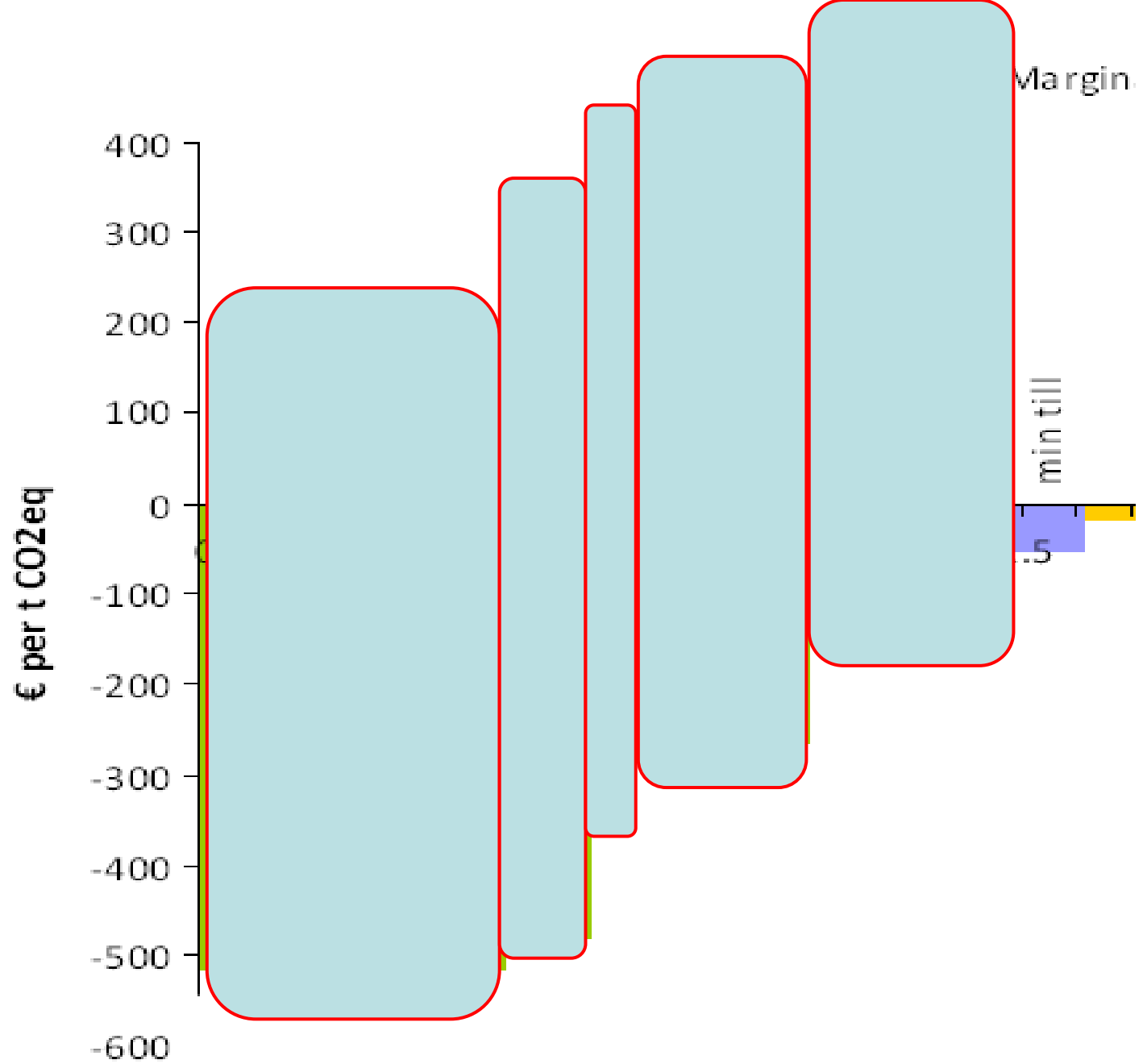
Different forms of actions

- ❑ 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

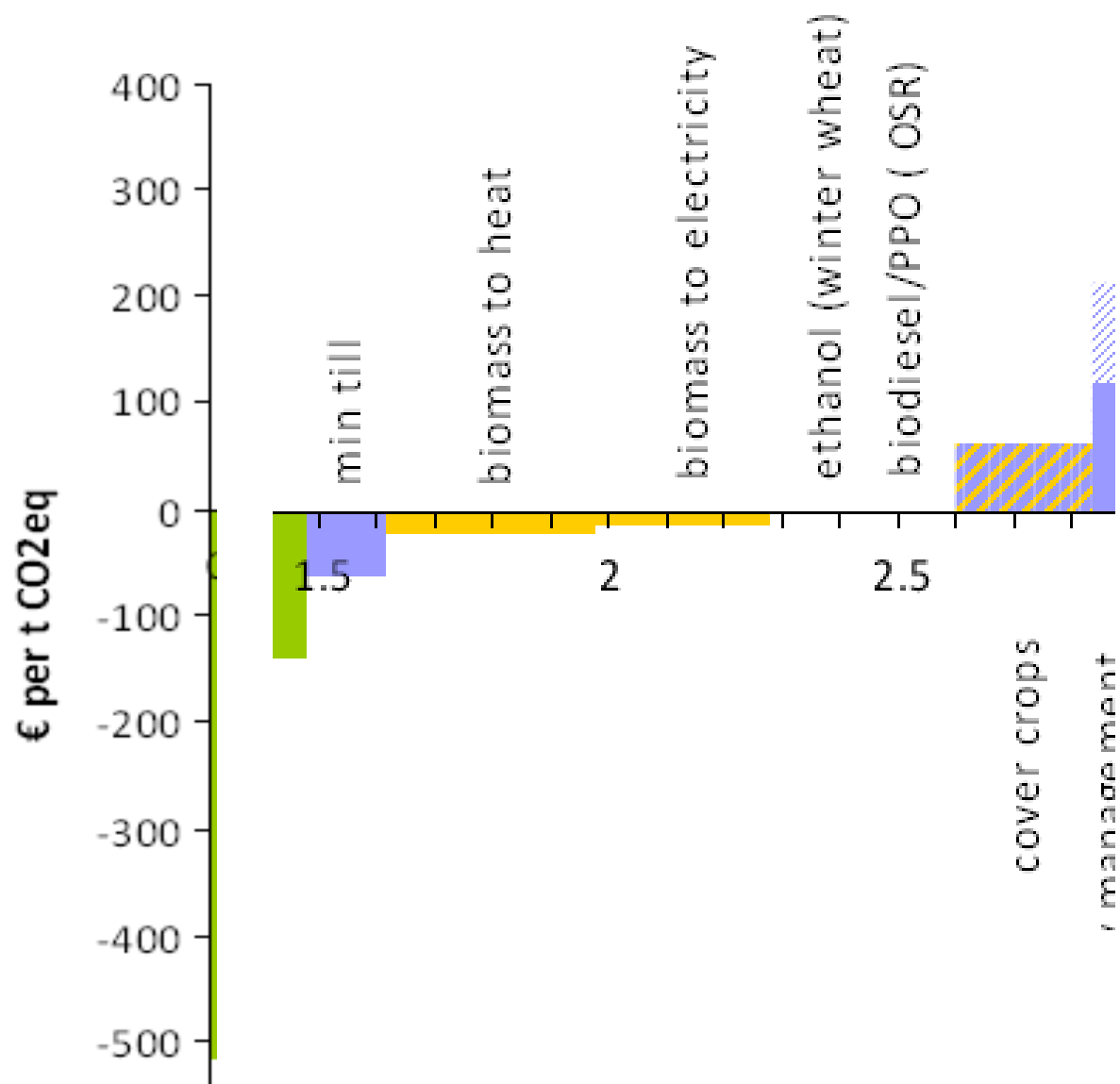
WIN–WINs – Reduced Emissions at the same time as increased farmer profit

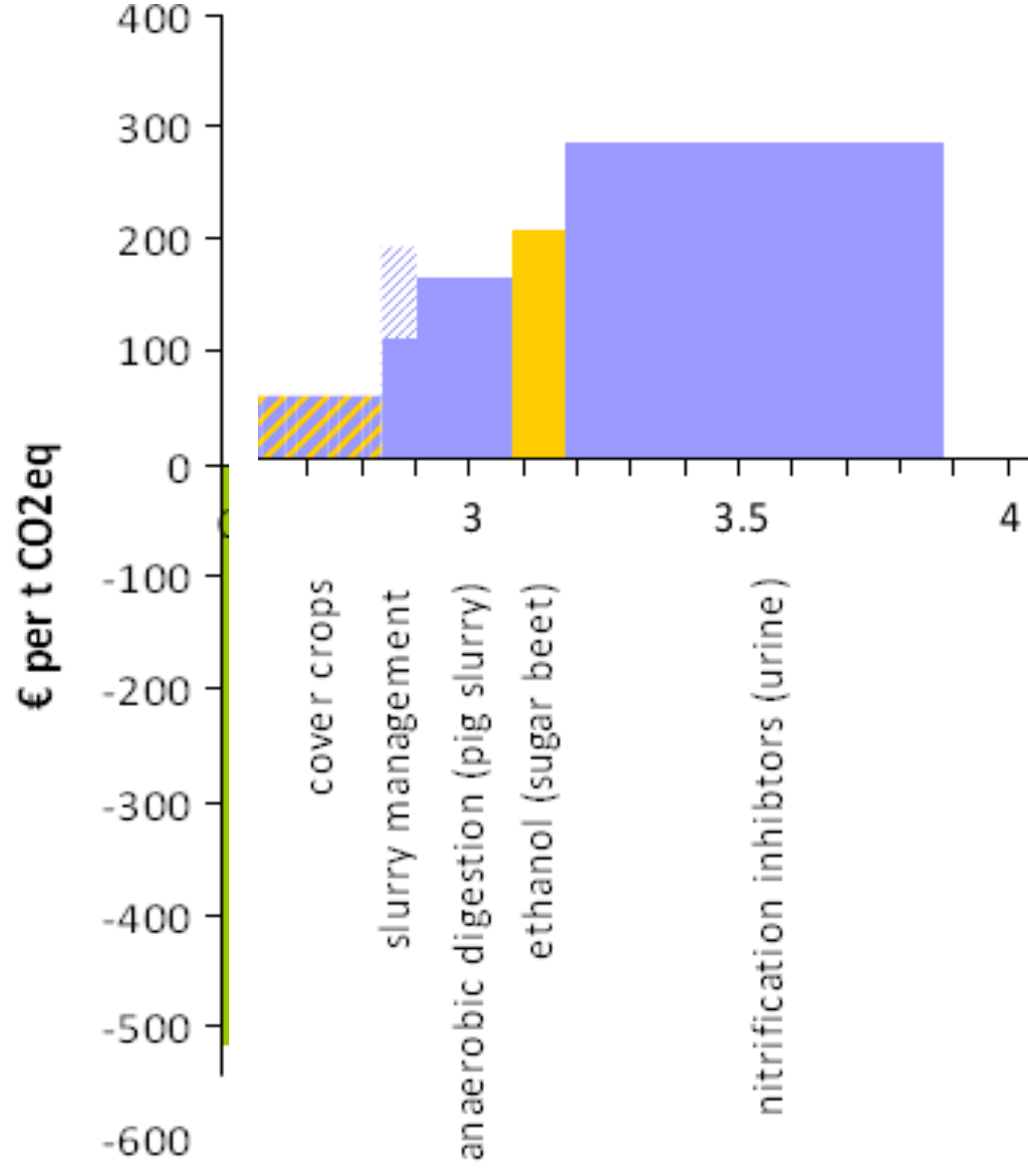
Marginal Abatement Cost Curve (LCA)



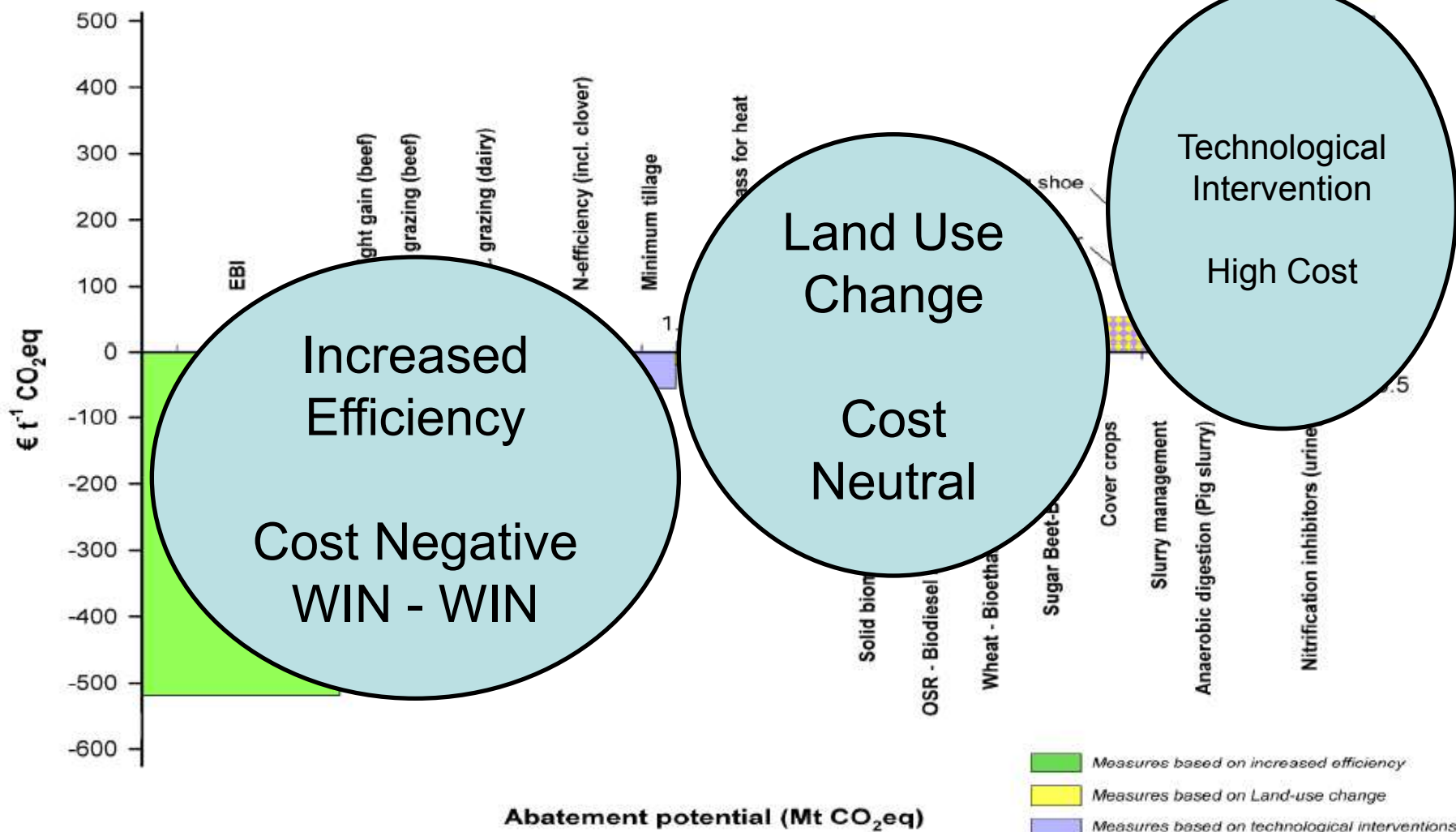


Marginal Abatement Cost Curve (LCA)





Marginal Abatement Cost Curve (LCA)



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

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



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



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



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.



Farmer Name

Pat Murphy

County

Kilkenny North

Soil Type

Moderately Drained

Area farmed (ha)

85

Plan Year

2014

Average number of dairy cows

100

Average number of cows planned (3 years)

130

Livestock Units Other Stock

60

Livestock Units Other Stock (3 years)

30

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	Grazing Season Current Target Low Good Excellent	-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	EBI Current Target Low Good Excellent	-6.0%	+€3900
Nitrogen Efficiency	Stocking rate (Kg N / Ha grass)	160.00	160.00	Nitrogen Usage Current Target Low Good Excellent	-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	Manure Management Current Target Low Good Excellent	-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	☒	☒	Energy Efficiency Current Target Low Good Excellent	-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



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



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



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



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



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



Bord Bia Teagasc Carbon Navigator

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

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	Grazing Season Suckler Cows Current Target Low Good Excellent	-2.5%	+€1509
	Housing Date	01/Nov	15/Nov			
Grazing season - yearlings/followers	Turnout Date	24/Mar	10/Mar	Grazing Season Yearlings Followers Current Target Low Good Excellent	-1.9%	+€2208
	Housing Date	01/Nov	15/Nov			
Age at first calving	Age at first calving (months)	30.2	28.0	Age At First Calving Current Target Low Good Excellent	-0.7%	+€773
Calving Rate	Calving rate (calves/cow)	0.8	0.9	Calving Rate Current Target Low Good Excellent	-8.3%	+€3010
Live weight performance	System	Steers & Heifers	Steers & Heifers	Live Weight Performance Current Target Low Good Excellent	-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	Nitrogen Efficiency Current Target Low Good Excellent	-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	Manure Management Current Target Low Good Excellent	-4.3%	+€148
	% Summer following 1st cut	30	30			
	% Later in Summer	40	0			
	Application Method	Splash Plate	Splash Plate			

Update