Greenhouse Gas Emissions and Agriculture's Contribution

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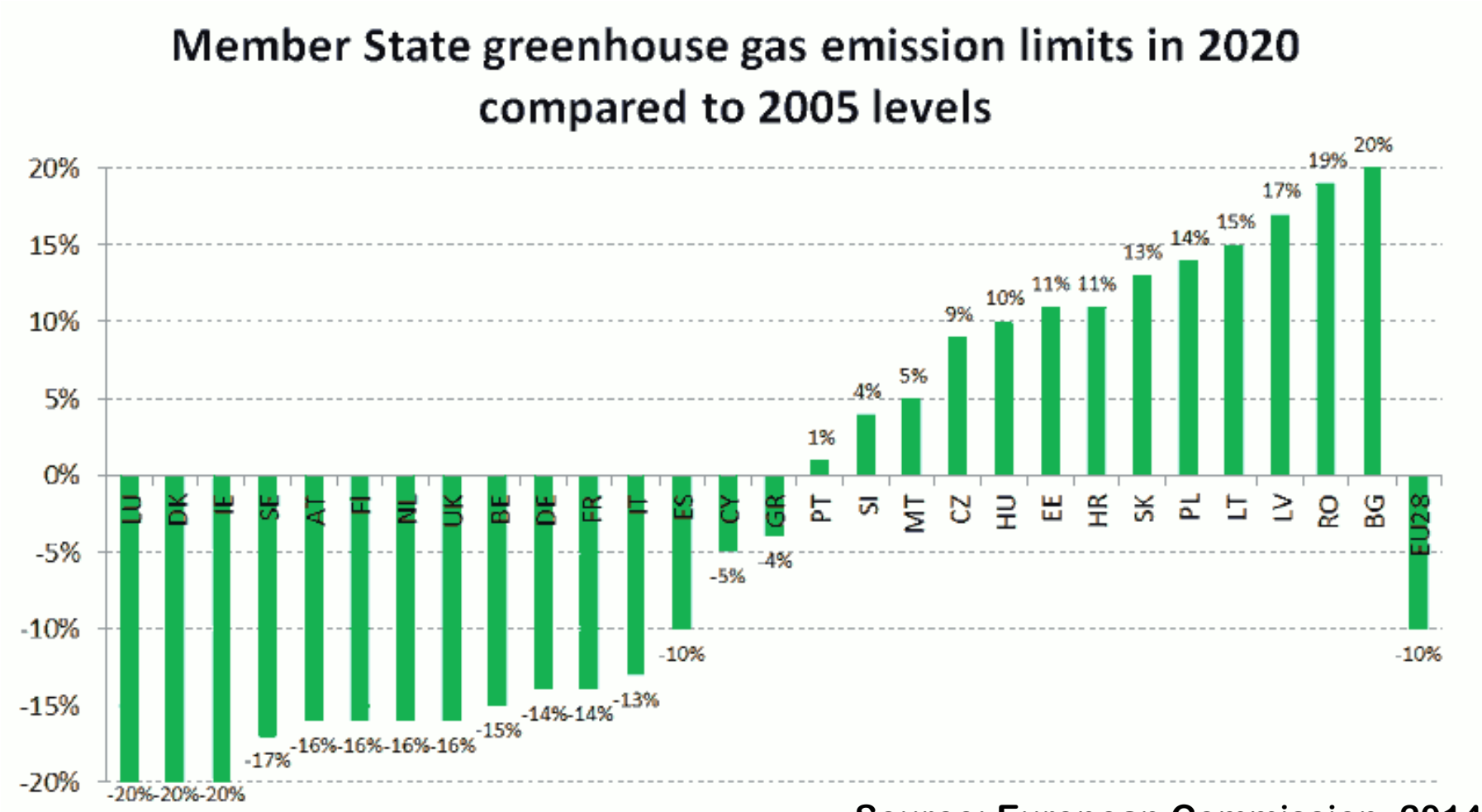
GHG Policy in the EU

- **EU 20 20 by 2020**
  - Proposed to cut emissions by 20% by 2020 relative to 1990
  - Potential to go to a 30% cut
  - 21% reduction in ETS emissions relative to 2005
  - 10% reduction in non-ETS emissions relative to 2005
- **20% ↓ in Irish Non-ETS emissions**
  - From 2005 base; no sector-specific targets yet
- **Renewables to contribute 16% of total energy consumption**

GHG limits under 2020 Agreement

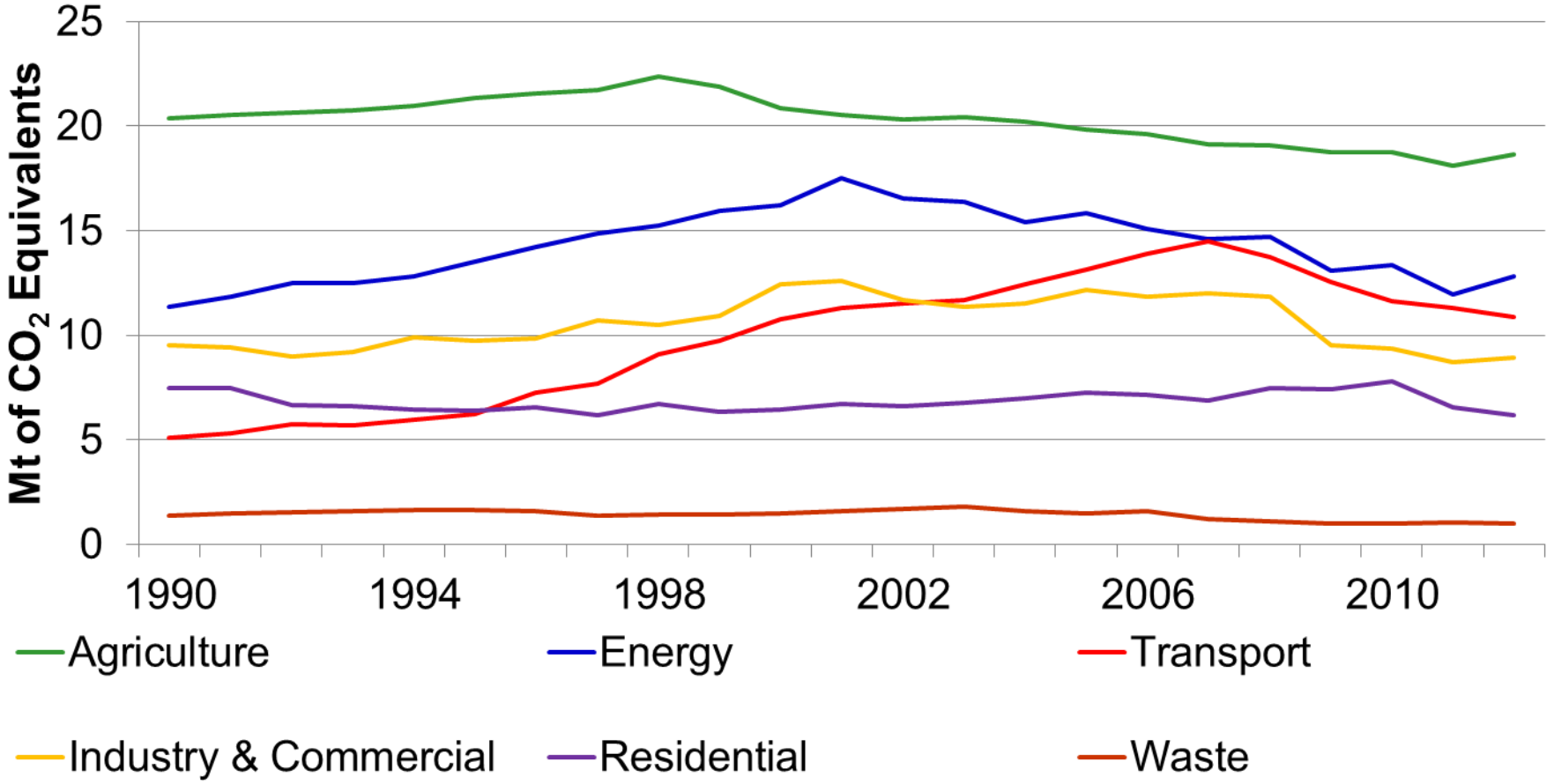


Source: European Commission, 2014

Ireland an Interesting Example

- **Agriculture is a major source of GHG emissions in Ireland**
- **GHG emissions from agriculture dominated by the ruminant sector**
- **Agriculture sector is largely export orientated and has targeted substantial growth especially in the dairy sector**

Ireland's GHG Emissions 1990 - 2012

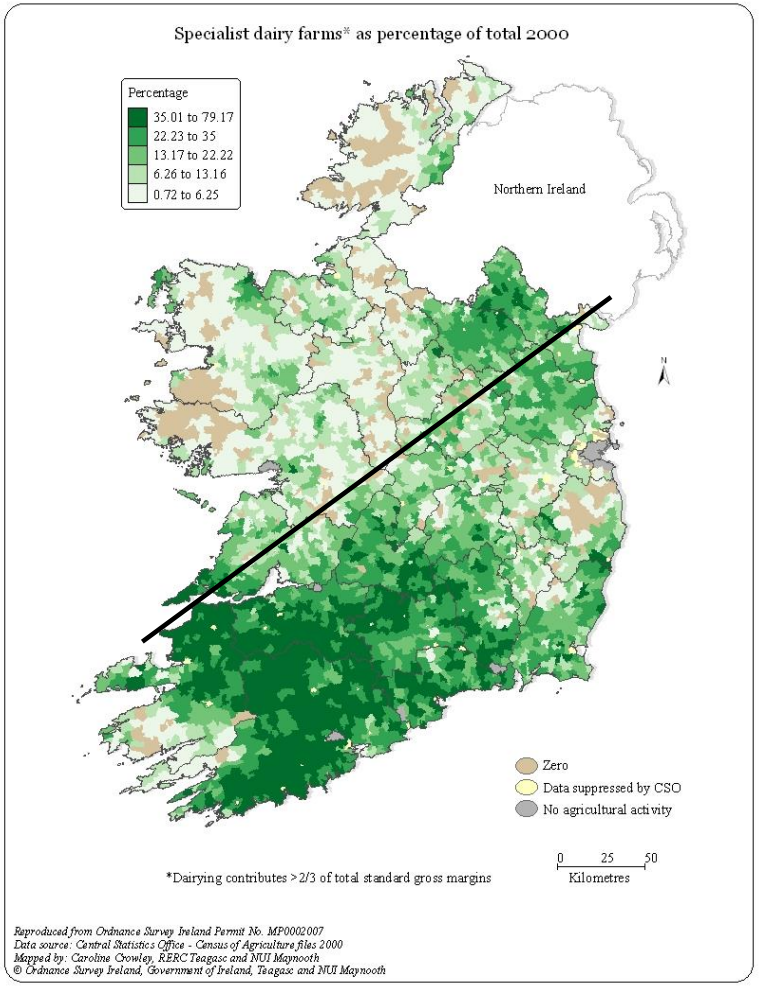


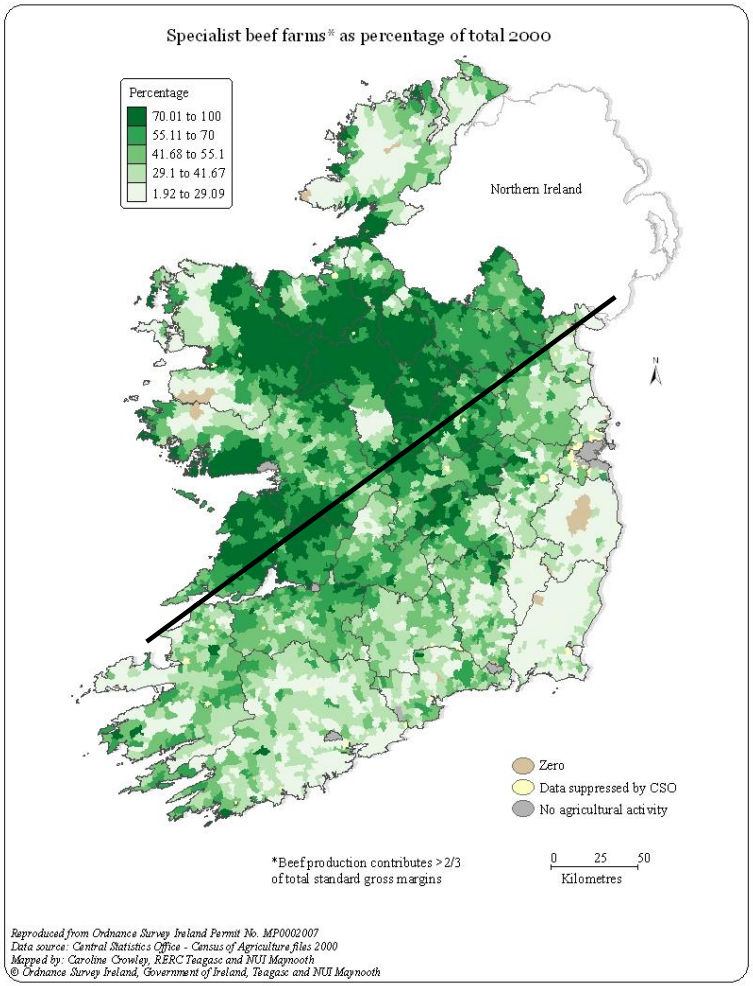
Source: EPA, 2014

Ireland's Agriculture sector

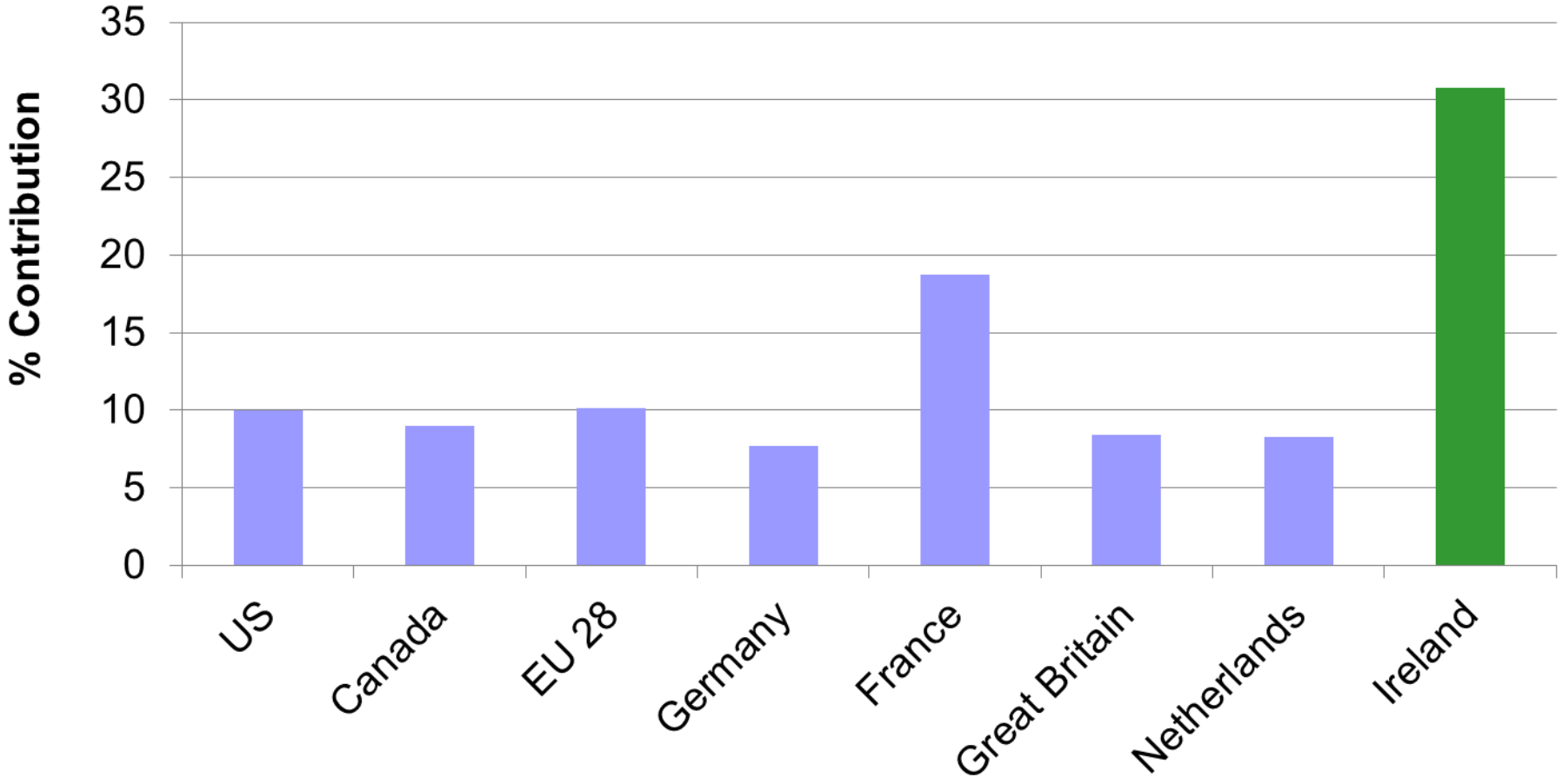
- **Grass Based**
- **Predominantly livestock**
- **South and East versus Border Midlands and Western Region**
- **Heterogeneous farms**
- **Multiple Enterprises**

Irish Agriculture





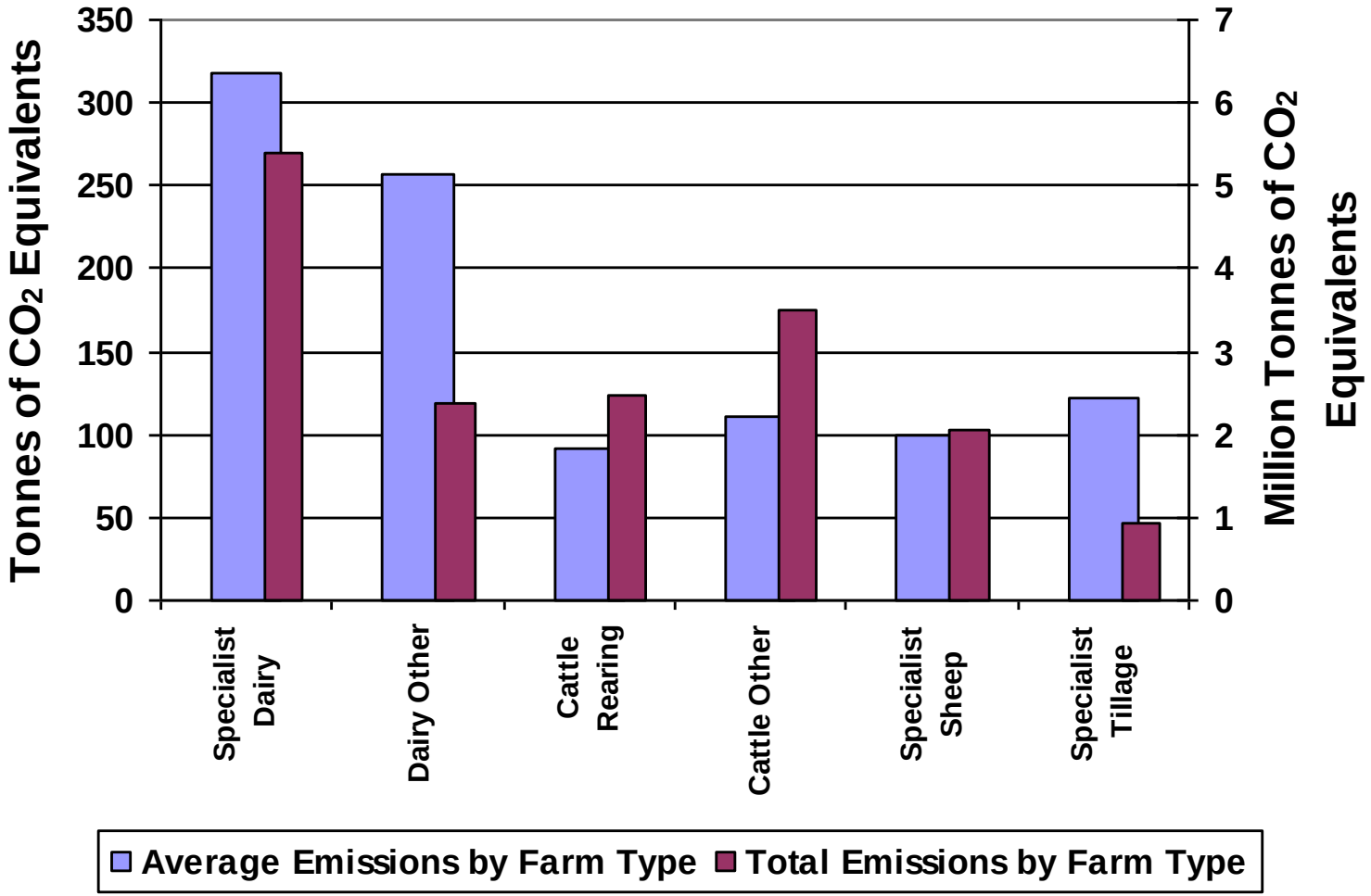
Agriculture's contribution to GHG emissions



GHG Emissions from Farms

- **Farms are not homogeneous**
- **Average emissions per farm varies according to**
  - Farm size
  - Farm type
  - Farm intensity

GHG Emissions by Farm Type



Reducing GHG emissions from Agriculture

- **What are the likely implications of reducing GHG emissions from agriculture?**
  - How much would it cost farmers to reduce GHG emissions?
  - What are the implications for the sector?
- **Marginal abatement cost is the cost of removing the last unit of pollutant**
- **The marginal abatement cost of GHG emissions varies both**
  - Within farm type
  - Between farm type

Reducing GHG emissions from Agriculture

- **How can we reduce GHG emissions from agriculture?**
- **Reduce the activity level i.e. have fewer animals**
- **Change activities to one that produces less emissions i.e. replace cows with crops**
- **Reduce the emissions coefficients through abatement technologies e.g. reduce the amount of CH_4 produced by a dairy cow**

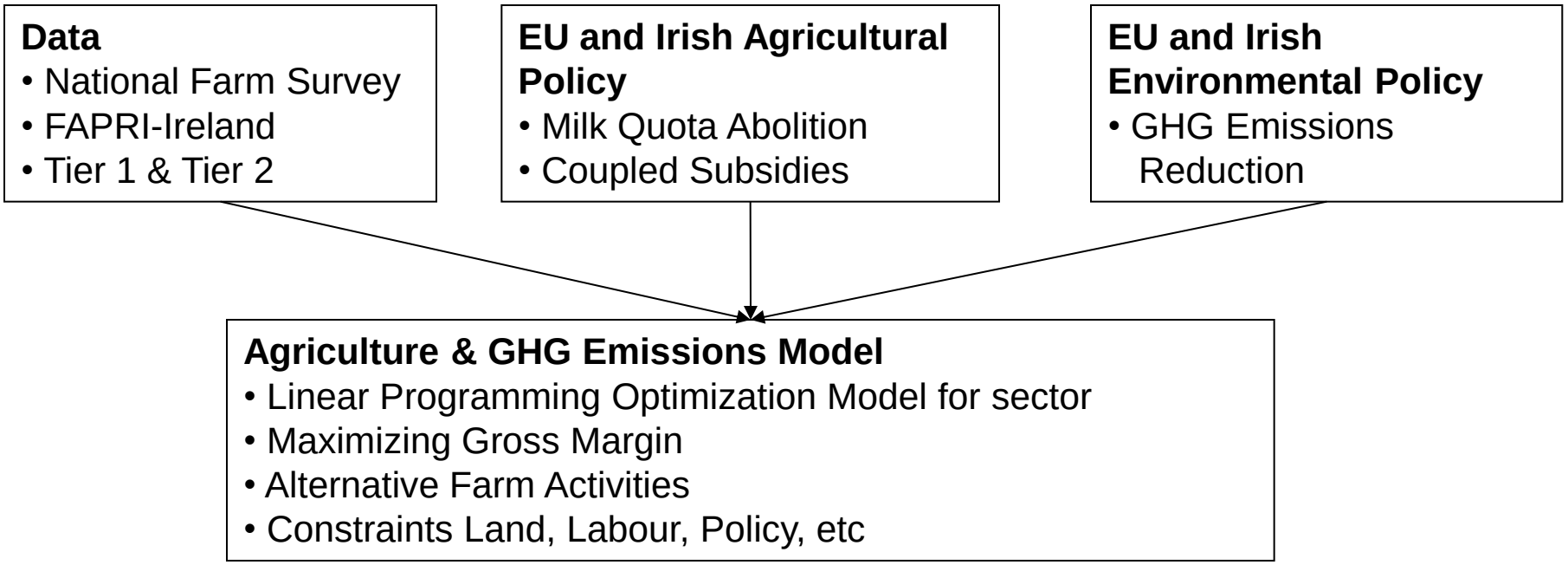
Farm-Level Analysis

Modelling Framework

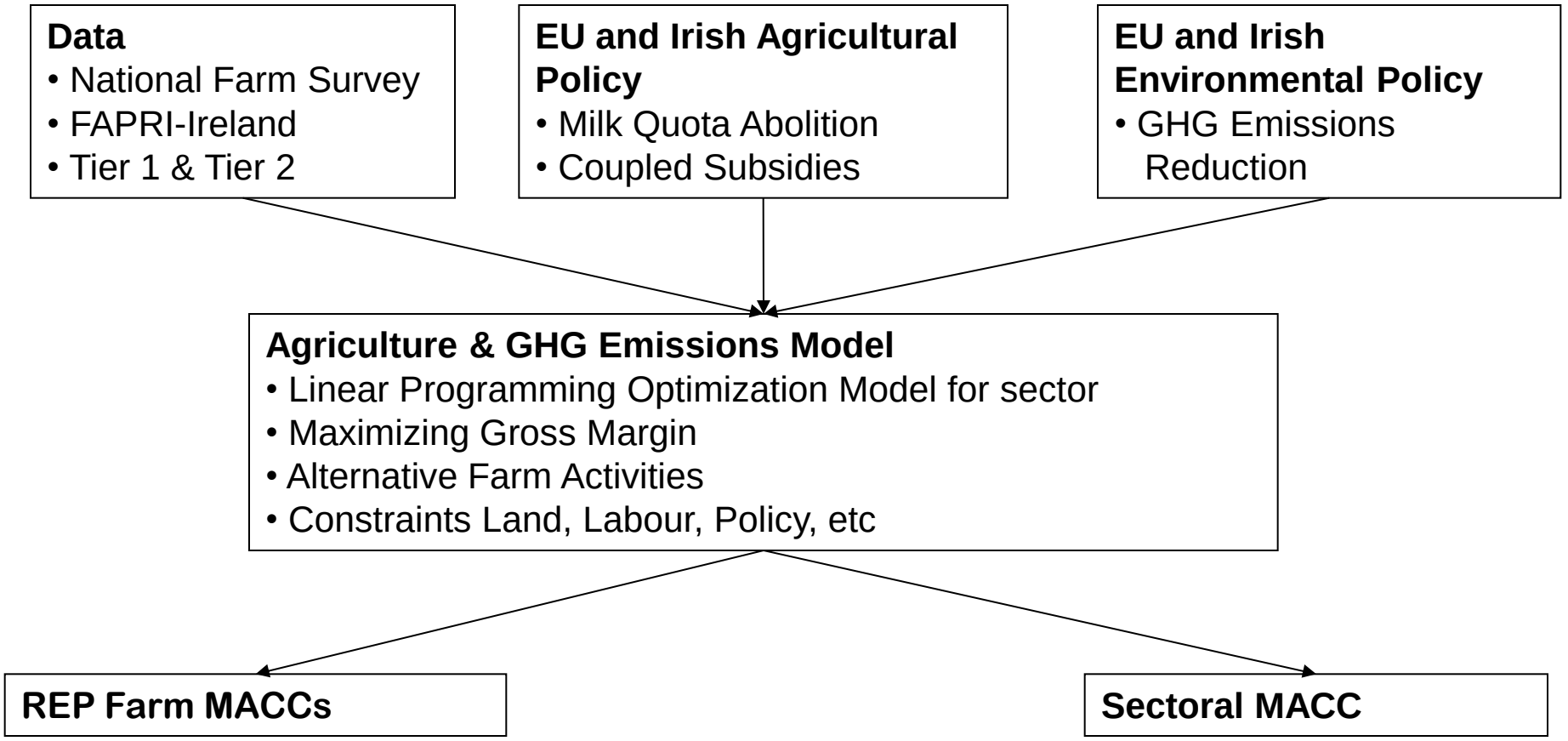
Agriculture & GHG Emissions Model

- Linear Programming Optimization Model for sector
- Maximizing Gross Margin
- Alternative Farm Activities
- Constraints Land, Labour, Policy, etc

Modelling Framework



Modelling Framework



Model Description

$$\underset{x_{ijt}}{Max}\ \Pi = \sum_{i=1}^{N}\sum_{j=1}^{J}\sum_{t=0}^{T}\left[c_{ijt}x_{ijt}\right]$$

- **Subject to**

$$\sum_{j=1}^{J} a_{kijt}x_{ijt} \le b_{kit}$$

$$\sum_{j=1}^{J} g_{sijt}x_{ijt} \le s_{st}$$

$$x_{ijt} \ge 0$$

$$i \in \{1,...N\};\ j \in \{1,...J\};\ t \in \{1,...T\};\ k \in \{1,...K\};\ s \in \{1,...S\}$$

- **Where:**
- **Π is farm gross margin**
- ***i* is an index for the set of farms of dimension N**
- ***j* is an index for the set of decision variables (activities) of dimension J**
- ***t* is an index for the set of time periods (years) of dimension T**
- ***k* is an index for the set of farm-level resource constraints of dimension K**
- ***s* is an index for the set of sector-level constraints of dimension S**

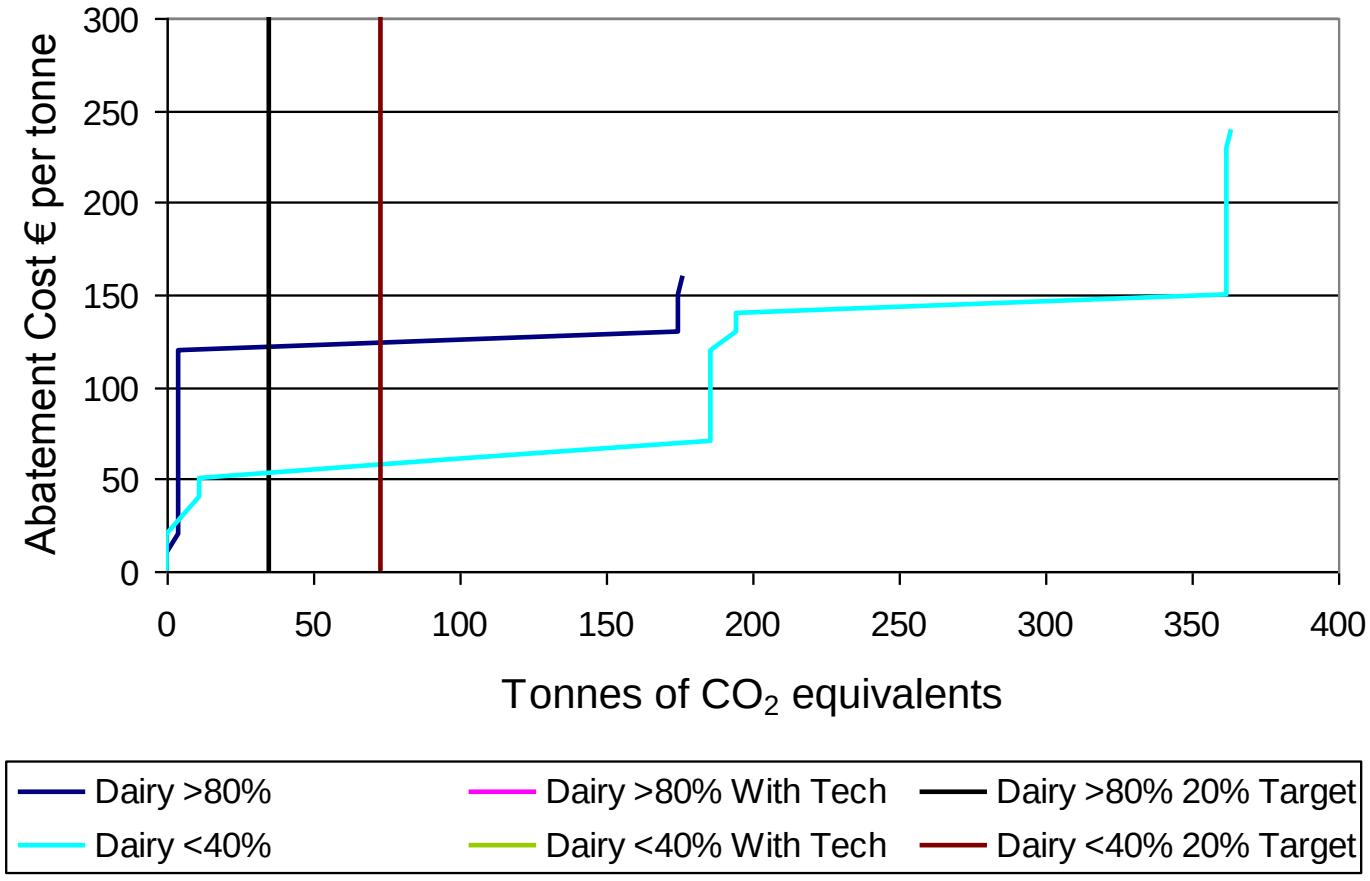
Data and Methods

- **Introduce an incremental notional emissions tax per tonne of CO_2 equivalents**
  - This leads to an increase in the cost of production
- **Can reduce emissions by**
  - Cutting production
  - Changing product mix
  - Adopting emissions abatement technology
- **Measure the volume of emissions reduction as a result of emissions tax**

Data and Methods

- **11 Representative Farms**
  - 3 Dairy Farms
  - 4 Cattle Farms
  - 2 Sheep Farms
  - 2 Tillage Farms
- **Dairy and Tillage Farms are grouped on degree of specialisation**
- **Cattle and Sheep Farms are grouped on degree of Profitability**
- **Plot the marginal cost of emissions abatement**

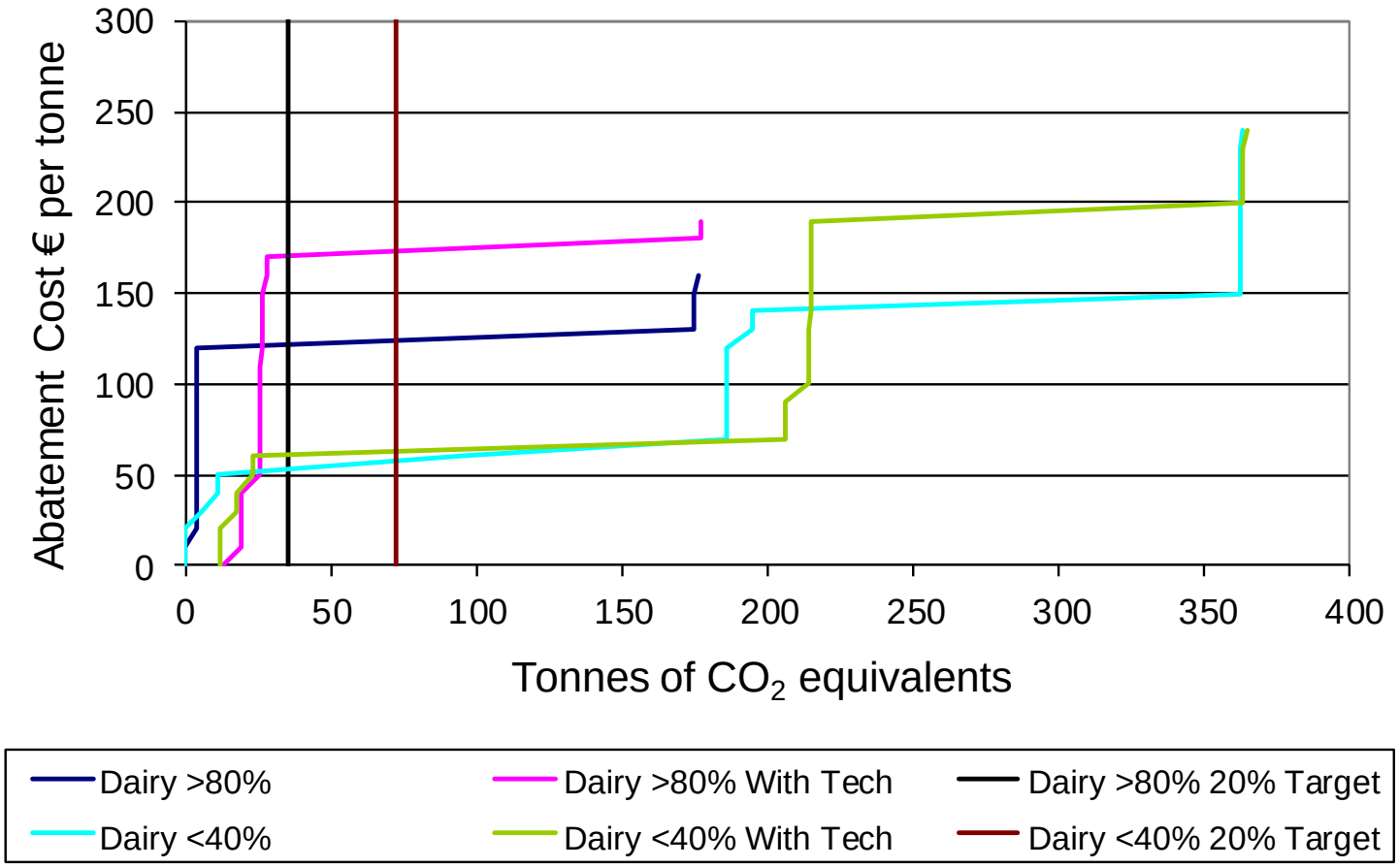
Marginal Emissions Abatement Cost Curve – Dairy Farms



Abatement Technologies

- **Can be grouped into three broad categories**
- **Negative cost or no cost**
  - Largely involves changes in management practices
- **Low-cost**
  - Changes in inputs
- **High-cost**
  - Typically involve substantial investment costs

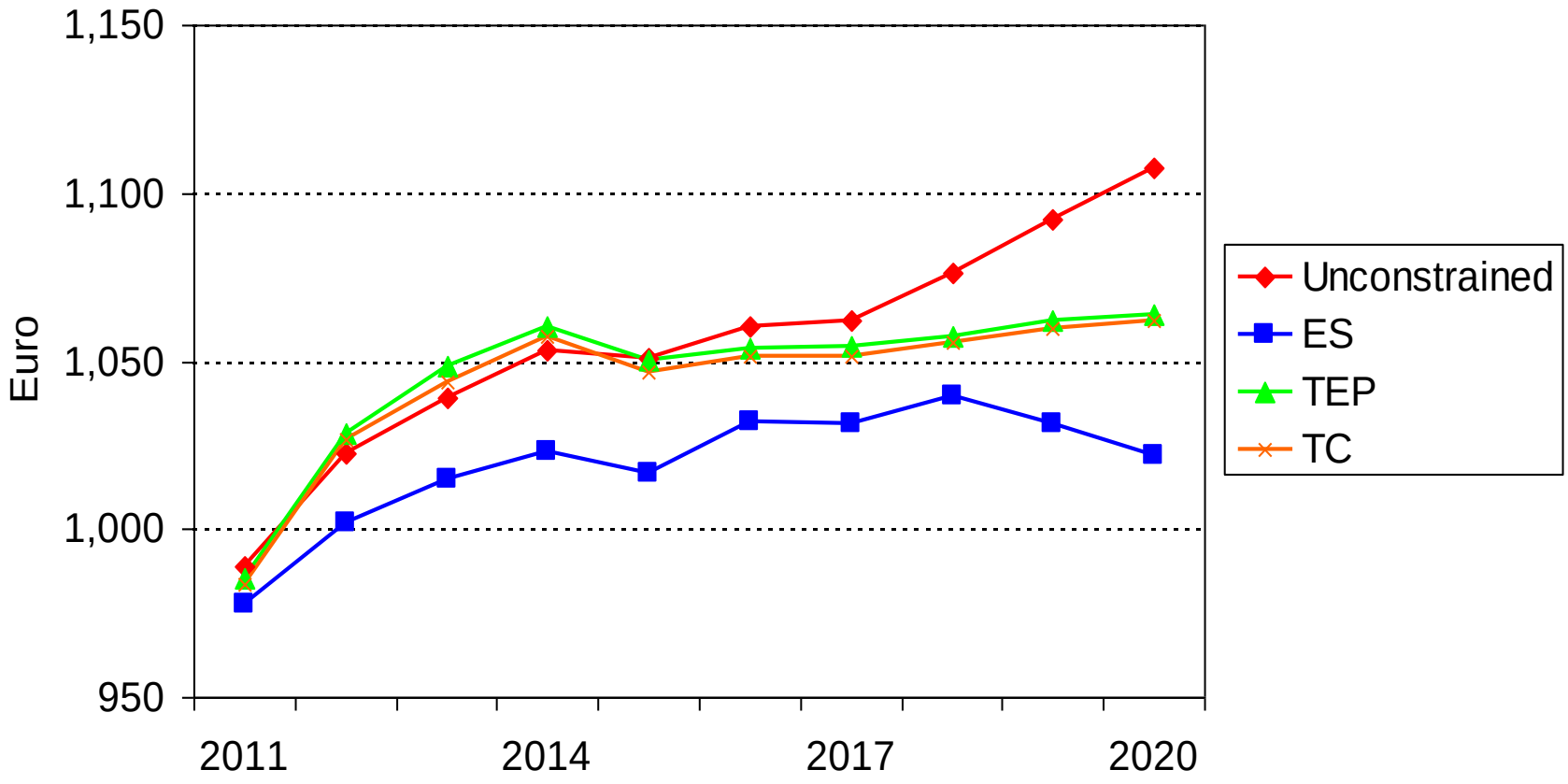
Marginal Emissions Abatement Cost Curve – Dairy Farms



How do we get farmers to adopt abatement technologies?

- **What factors will influence farmers decisions to adopt technologies?**
- **What kind of policies could we use to encourage adoption?**
- **“Carrot or Stick”**
  - Abatement Subsidies, grants, soft loans, etc.
  - Emissions Standard, Taxes, Tradable Emissions Permits, etc.
- **Market driven adoption**
  - Carbon footprinting, Teagasc and Bord Bia “Carbon Navigator”
- **The role of extension**

Projected Average Dairy Farm Gross Margin per hectare



Sectoral-Level Analysis

Policy for the Irish Agricultural Sector

- **In response to the economic recession, Irish government has focussed on job creation**
- **Committee of agri-food experts appointed to draft a strategy for export driven growth in the agri-food sector**
- **Food Harvest 2020 report published in 2010 and adopted as official government policy**

Policy for the Irish Agricultural Sector

- **EU milk quota regime is to be discontinued in 2015**
- **Irish milk production uses a low cost grass-based system**
- **50% increase in volume of milk production targeted by 2020**
- **20% increase in the value of beef and sheep output targeted by 2020**

Reconciling Policies

- **To achieve the FH 2020 target for dairy means more dairy cows**
- **More dairy cows means more emissions**
- **More dairy cows means more dairy offspring which means more emissions**
- **Ireland needs to reduce its GHG emissions to comply with the 2020 targets**
- **Conflicting Policies**

Scenario Development

- **FAPRI-Ireland examined the compatibility of these policies**
- **In the absence of abatement technologies**
- **50% increase in milk output achieved**
- **10% reduction in GHG emission from agriculture by 2050 relative to 2005**

Agricultural Projections

		Reference Scenario	GHG Minus 10%	2050 Reference v 2005	GHG Minus 10% v 2005	GHG Minus 10% vs Reference 2050
	2005	2050	2050			
	million head			percent change		
Total Cattle	6.34	5.82	4.09	-8%	-35%	-30%
Dairy Cows	1.10	1.43	1.43	30%	30%	0%
Suckler Cows	1.11	0.68	0.08	-39%	-93%	-88%

GHG Policy Developments in the EU

GHG Policy in the EU – Latest Developments

- **UN summit on Climate Change to be held in Paris in December 2015**
- **With-this in mind EU committed by 2030 to reduce GHG emissions by 40%**
- **27% target for renewable energy and energy efficiency**
- ***Flexibility clause* to re-examine targets post 2015**
- **Special case of agriculture acknowledged.**

GHG Policy in the EU – Latest Developments

- **Clause 2.14**
  - *The multiple objectives of the agriculture and land use sector, with their lower mitigation potential, should be acknowledged, as well as the need to ensure coherence between the EU's food security and climate change objectives. The European Council invites the Commission to examine the best means of encouraging the sustainable intensification of food production, while optimising the sector's contribution to greenhouse gas mitigation and sequestration, including through afforestation. Policy on how to include Land Use, Land Use Change and Forestry into the 2030 greenhouse gas mitigation framework will be established as soon as technical conditions allow and in any case before 2020.*

GHG Policy in the EU – Latest Developments

- **Clause 2.14, four key points**
  1. Acknowledges that agriculture and land use have limited mitigation potential
  2. Need for coherence between the EU's food security and climate change objectives.
  3. Sustainable intensification of food production, while optimising the sector's contribution to GHG mitigation and sequestration, including through afforestation.
  4. Policy to be established as soon as technical conditions allow.

GHG Policy in the EU – Latest Developments

- **What does Clause 2.14 mean?**
- **Potentially adjust individual member states GHG targets based on the contribution from agriculture**
- **Potentially separate Agriculture and Land Use, Land Use Change and Forestry off from the rest of the non-ETS sectors**
  - What would be the relative shares in terms of emissions reductions between the two sectors

Achieving Sustainable Intensification

- **Carbon Neutral Agriculture – Teagasc**
  - Increased Sequestration
  - Advanced Mitigation
  - Fossil Fuel Displacement
  - Constrained Production Activity
  - Residual Emissions

Achieving Sustainable Intensification

- **The role of extension or knowledge transfer**
  - Example: Carbon Navigator – Teagasc in conjunction with Bord Bia
  - Farm-level decision support tool to reduce GHG's
- **The role of the market**
  - Example: Origin Green – Bord Bia
  - National Sustainability programme

Conclusions

- **GHG reduction targets likely to have a substantial impact on agriculture and on farmers**
- **Reconciling food production with GHG emissions policy is challenging**
- **The European Council's latest document represents a positive step in terms of agriculture's contribution**

Conclusions

- **Understanding farmer behaviour will be very important.**
- **How do we design policies to achieve emissions reduction and encourage adoption of abatement technologies?**