Ruminant Diet and Management
Its role GHG Abatement

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IT NEWS SPORT BUSINESS OPINION LIFE & STYLE CULTURE MOR

Ireland's agriculture emissions are hurtling in the wrong direction

Not meeting our 2030 targets could see Irish beef and dairy being produced by a country regarded as Europe's dirtiest emitter

2018, 01:00

INDEPENDENT

NEWS CORONAVIRUS ADVICE US POLITICS VOICES SPORT CULTURE INDY/LIFE INDYBEST

Cows fed seaweed i... climate change

Methane emitted by burping, passing wind and making ...

Tom Embury-Dennis | @tomemburyd | Friday 31 August 2018 13:00 |

The Sun

NEWS | TRAVEL | MOTORS | DEAR DEIDRE | PUZZLES

COWS that are genetically modified to produce less methane could have a major impact on climate change, a new study has found.

Scientists discovered that methane-producing microbes in cow stomachs are actually inherited by cows and think that selective breeding of cows that produce less of the greenhouse gas could cut methane emissions down by 50%.

Context… Evolution of the livestock sector 1980 to present

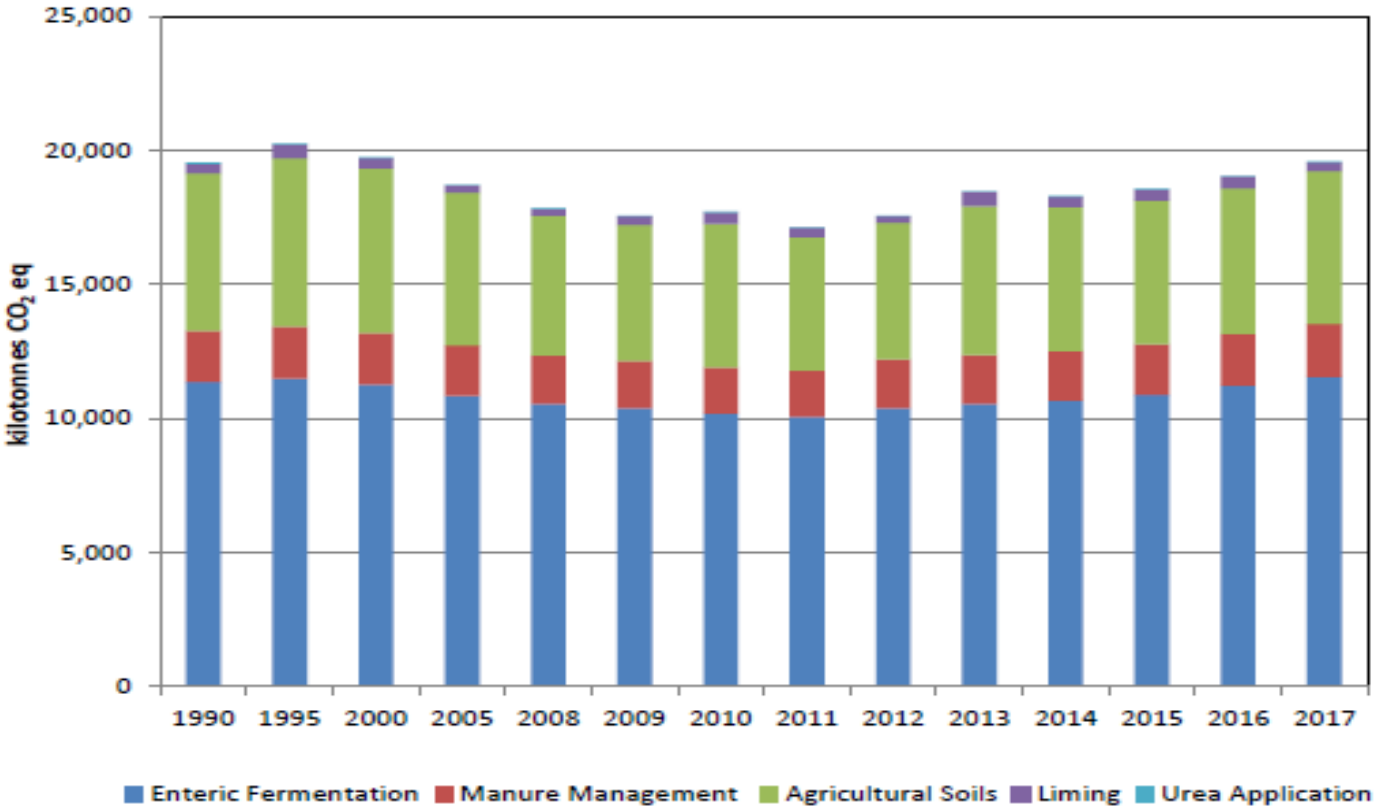
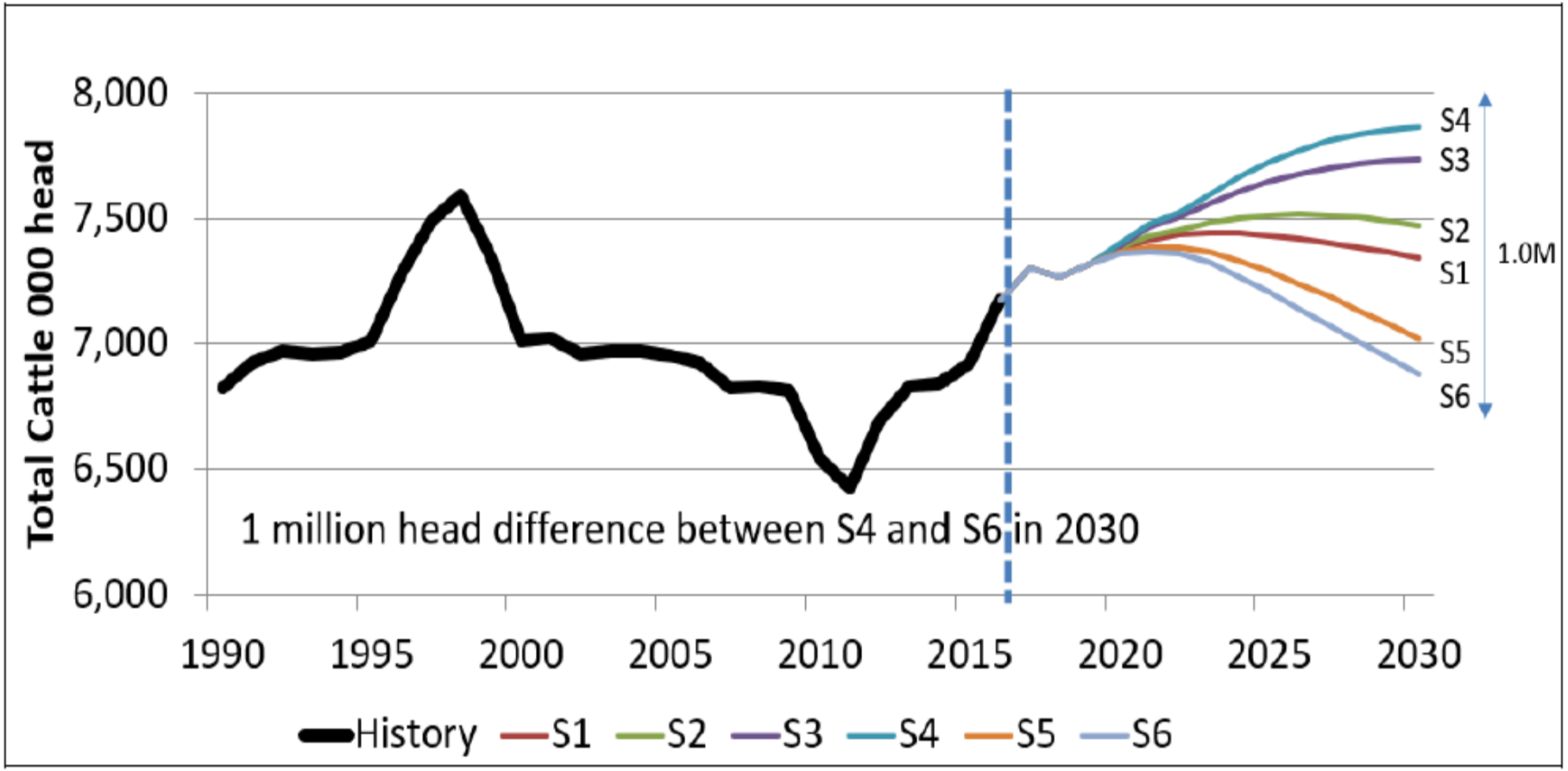


Figure 5.1 Total Emissions from Agriculture by Sector, 1990-2017

Context… Evolution of the livestock sector 1980 to present



Source: FAPRI-Ireland Model

MACC Agriculture 2021-2030

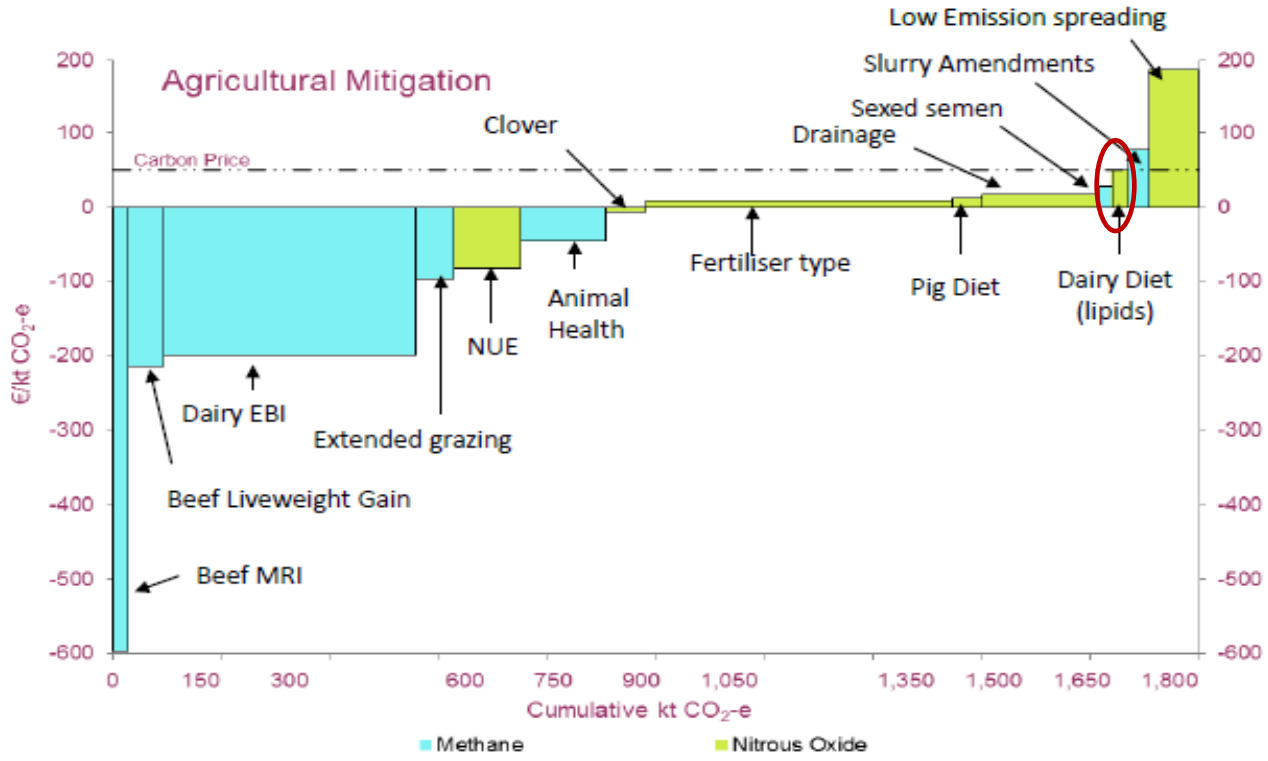
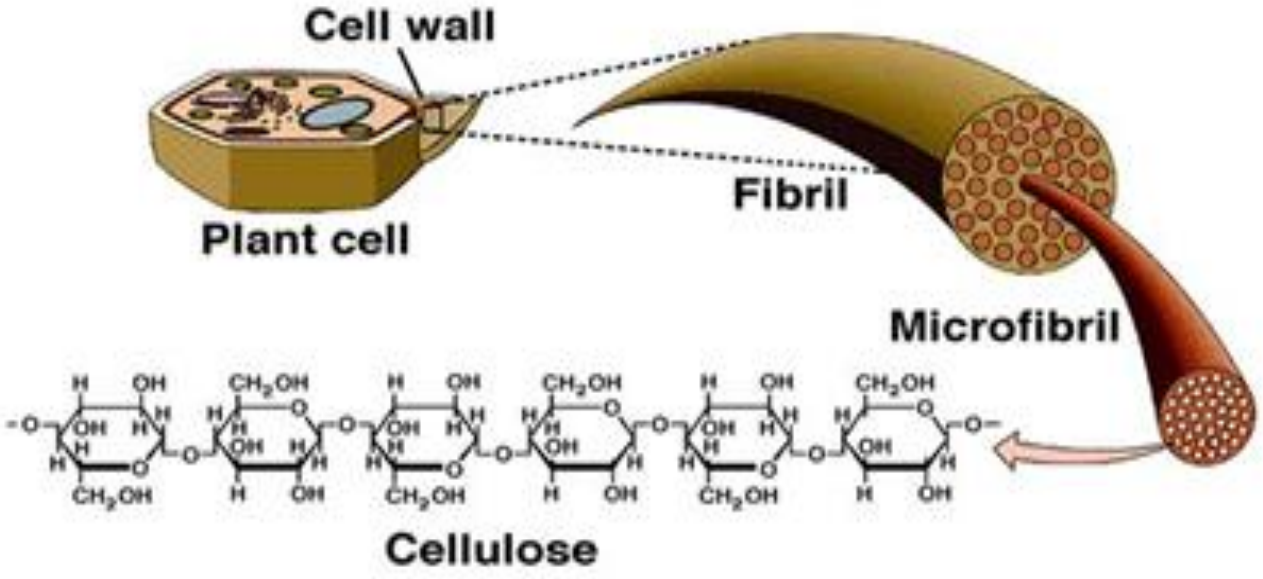


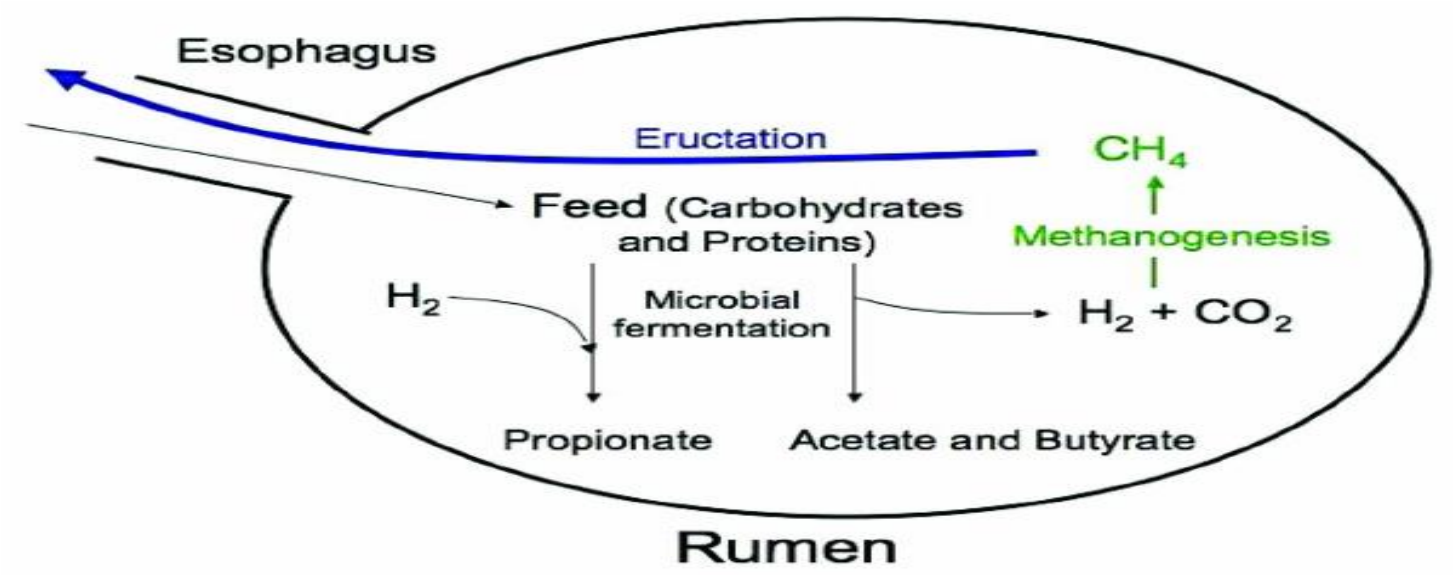
Figure 3.1: Marginal Abatement Cost Curve for agriculture for 2021-2030 (methane and nitrous oxide abatement). Values are based on linear uptake of measures between the years 2021-2030 and represent the mean yearly abatement over this period. Dashed line indicates Carbon cost of €50 per tonne CO_2.

Feed Energy Fractions and Ruminants

- **Simple sugars**
- **Fructan**
- **Starch,**
- **Pectin**



Methanogenesis: an embedded feature in rumen fermentation



Management factors can affect balance

- Forage fibre content
- Carb/N fractions
- Animal type/production level

Mediated through changes in rumen microbial population

Additives??

Current Research– Feed Additives

Research Example: 3 NOP- Effect on CH4 Emissions

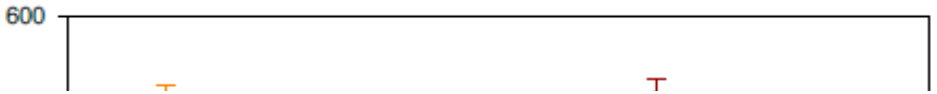


Table 1. Effect of 3-nitrooxypropanol (3NOP) on feed dry matter intake, lactation performance, and body weight change of Holstein dairy cows

	Treatment*					*P* value†		
Item	Control	Low3NOP	Medium3NOP	High3NOP	SEM‡	C vs. Trt.	L	Q
Dry matter intake, kg/d	28.0	28.0	27.7	27.5	0.45	0.58	0.38	0.69
Milk yield, kg/d	46.1	46.4	45.9	43.6	1.21	0.59	0.21	0.19
ECM yield, kg/d§	44.9	45.2	46.2	43.9	1.59	0.91	0.84	0.44
Feed efficiency kg/kg¶	1.64	1.65	1.67	1.62	0.033	0.94	0.80	0.41
Milk fat, %	4.08	3.98	4.02	4.25	0.123	0.98	0.43	0.15
Milk fat yield, kg/d	1.85	1.81	1.87	1.85	0.086	0.98	0.90	0.85
Milk true protein, %	3.06	3.14	3.12	3.13	0.033	0.07	0.14	0.31
Milk true protein yield, kg/d	1.37	1.46	1.45	1.33	0.042	0.42	0.75	0.02
Milk lactose, %	4.78	4.79	4.81	4.77	0.026	0.69	0.95	0.32
Milk lactose yield, kg/d	2.16	2.22	2.25	2.04	0.069	0.90	0.43	0.05
Body weight, kg	664	672	672	664	5.0	0.38	0.83	0.13
Body weight change, g/d#	210	353	451	330	71.2	0.05	0.09	0.16

Hristov et al, 2015

www.pnas.org/cgi/doi/10.1073/pnas.1515515112

Methane Feed Additives- Issues

- Verification of long-term effects
  - Rumen adaptation
- Inclusion rates and delivery in pasture systems
- Relative effects at different inclusions/animal types
- Cost and manufacturing scale
- Production and animal health effects
- Residues and toxicity
- Inventory

Research on Nitrous Oxide in Pasture Systems

- Multispecies swards for grazing dairy cows 2019-
- Ryegrass, timothy plus clovers, plantago, chicorium.
- Reduced fertilizer N- 100kg per ha

- Secondary compounds in plantain- aucubin
- Effect on urine patch N20 losses

- Plus animal productivity measures

(Finn et al, Teagasc, Johnstown Castle)

Research on Nitrous Oxide- Emissions from Excreta on Pasture

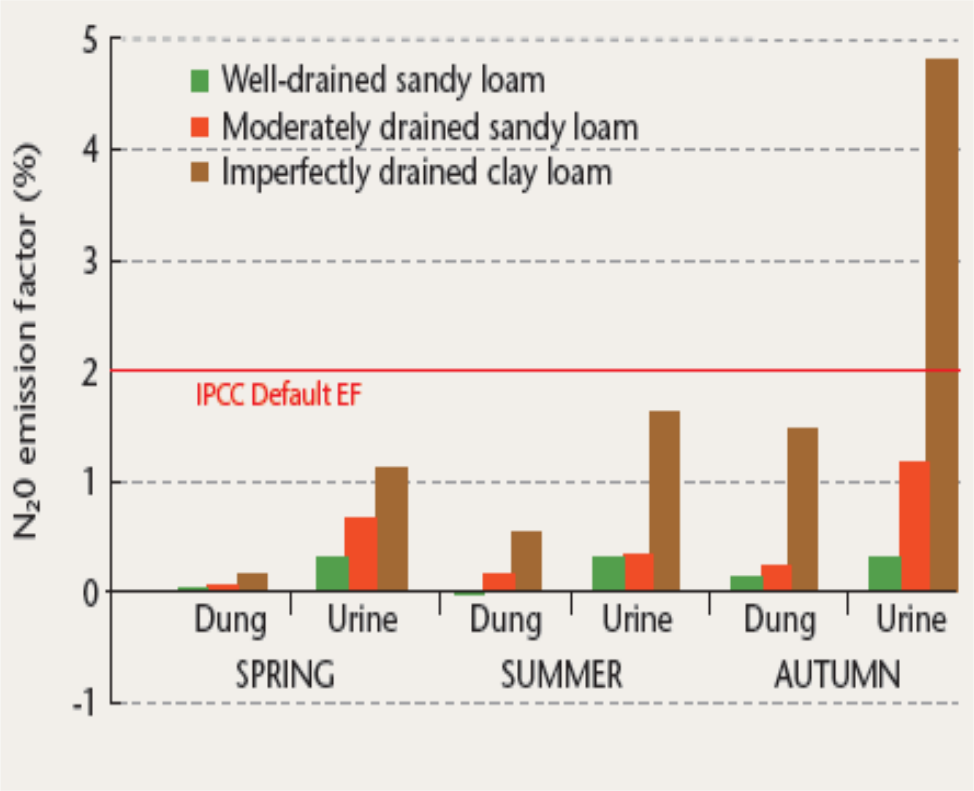
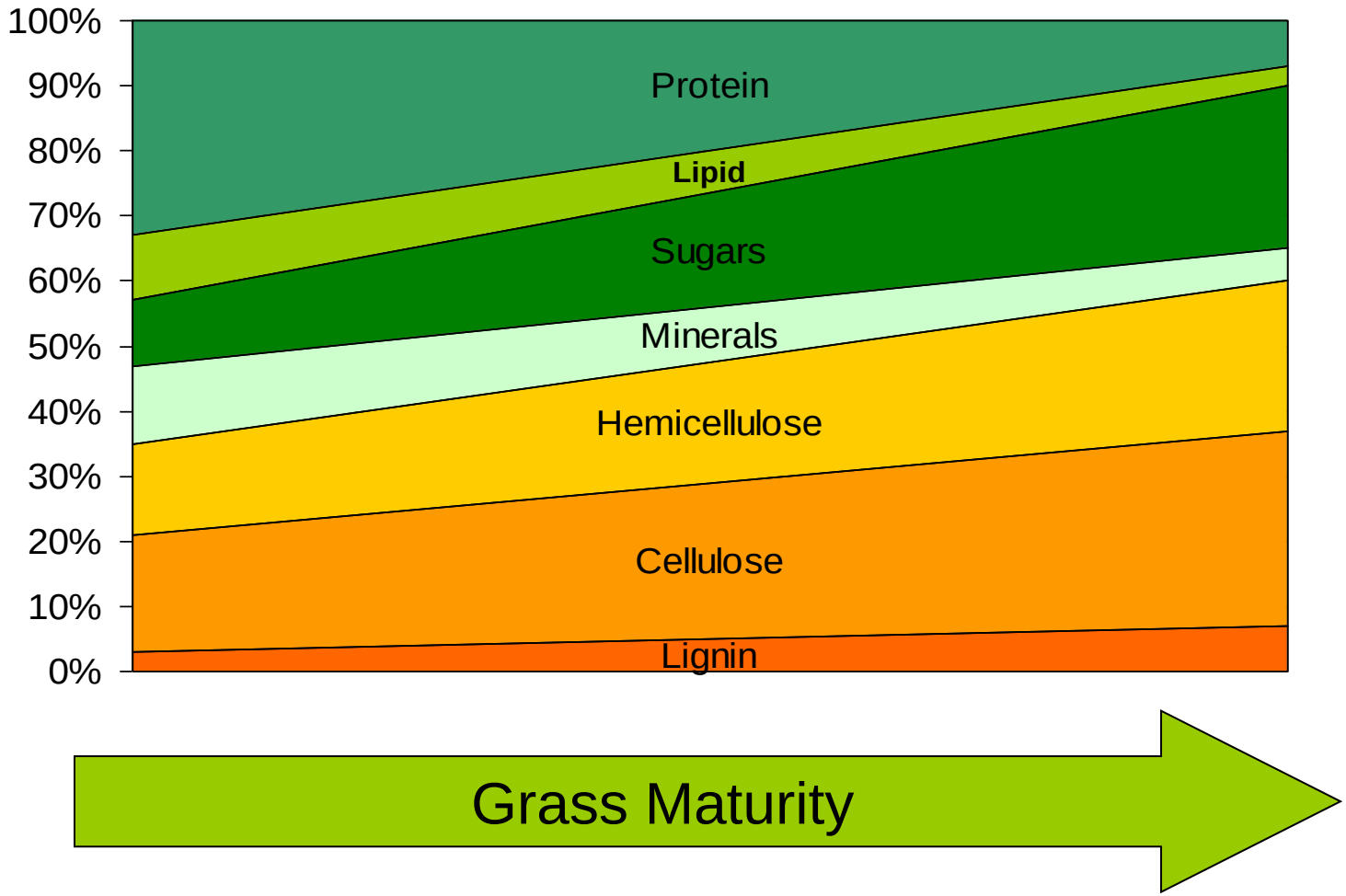


FIGURE 1: Direct nitrous oxide emission factors for different excreta sources, over three seasons and applied to three different soils.

- Emission Factors for N20 lower than inventory default
- Site, weather and season effects
- Urinary losses in autumn on wet soils most significant
- Research on-going into mitigation of UrN

(Krol et al, Teagasc, Johnstown Castle)

Chemical Composition of Pasture



Stage of grazing v N Profile

		Protein N Fraction		
Season	Stage	Soluble	Insoluble	Indigestible
Spring	2 Leaf	177.1	11.5	2.3
	3 Leaf	129.3	15.5	2.7
Summer	2 Leaf	133.4	26.1	3.1
	3 Leaf	112.2	21.4	4.1

Managing feed protein content in grass based systems

- Grazed too early: re-growth stage has higher soluble N fraction
- Grazed too late- fibre increased leading to higher CH4 potential
- Grazing management is key

- Nitrogen (PDIN) generally not limiting
- Supplement with Hi-ferm energy sources to achieve PDIE balance
- Conserved forage (silage protein) content too low- improve management
- Break the assumed link between ‘crude protein’ and quality

Summary and Conclusions

- Rumen methane production remains a key CO2 challenge
- High performance animals and diets reduce footprint per kg product

- Rumen-based mitigation to address absolute emission levels
- Much research done- limited by persistence of effects
- Newer technologies showing promise

- Nitrous oxide on pasture- evidence of variable emission factors due to soil, weather and N conditions
- Specific nutrients in pasture diets to shift fractions away from urinary N

- Extension effort required to improve pasture and conserved forage quality, plus shift thinking on crude protein in grass based diets