



Beef Eating Quality - a European Journey

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Beef Eating Quality - a European Journey



- Challenges for the European beef industry
- Beef quality assurance
- Recent research
- Way forward?



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Diversity







“European beef industry”



- Diversity of:
 - Breeds
 - Rearing regimes
 - Processing
 - Consumer preferences



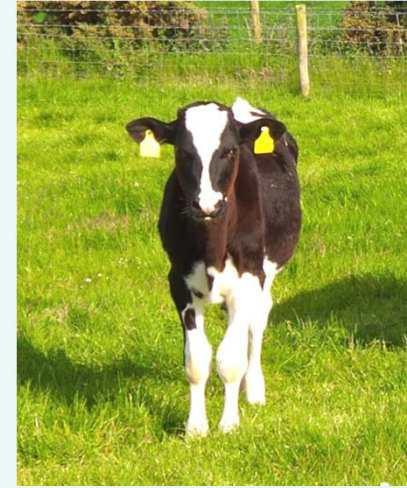
How would you like your steak?

1.  RARE
2.  MEDIUM RARE
3.  MEDIUM
4.  MEDIUM WELL
5.  WELL DONE 

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Challenges

- Environmental impact
 - Carbon footprint
 - Animal Welfare
 - Authenticity
 - Nutrition & health
 - Price
 - Quality
- } **Value for money?**



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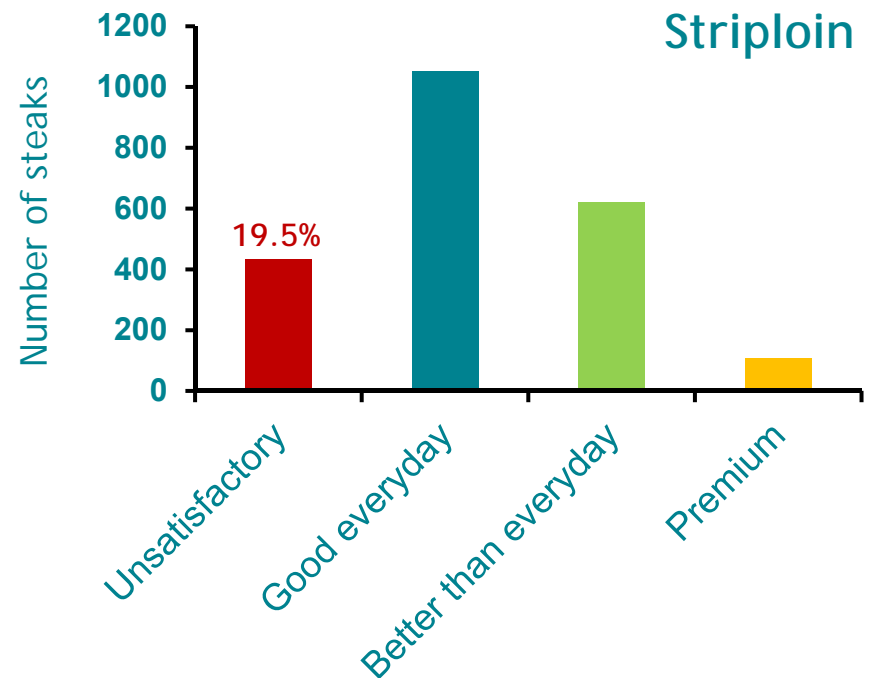
Value for Money?

European consumer studies on beef:

- 774 carcasses, 18 muscles, 15,000 consumers, 5 countries:
 - 20% grilled striploin
 - 25% grilled rump
 - 54% roast topside

= "Unsatisfactory"

Bonny, S. et al. 2015; Farmer et al., 2016



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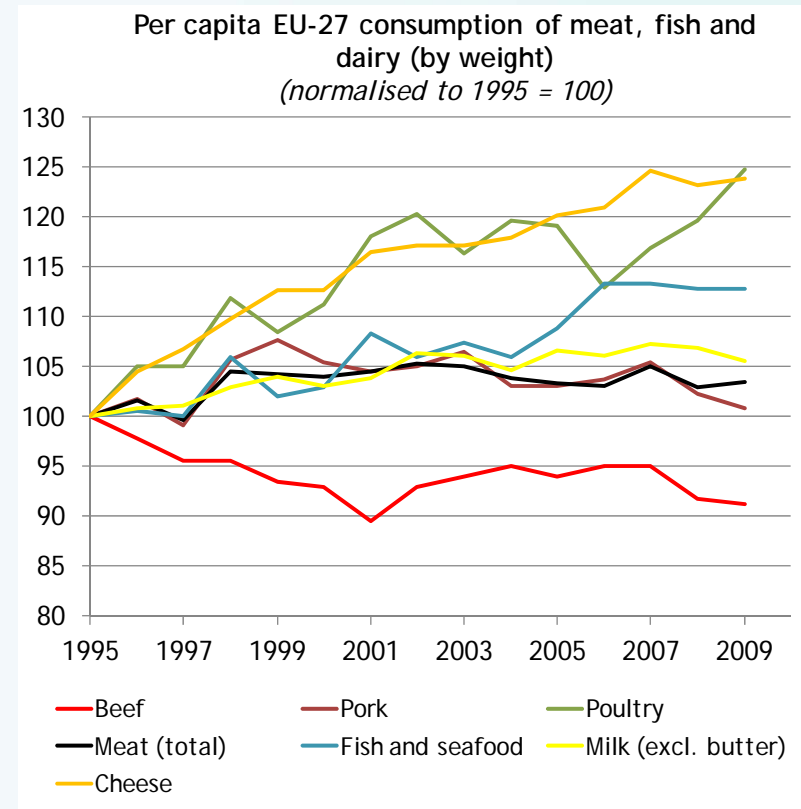
Value for Money?

Beef is expensive and inconsistent

- Consequences?
 - Declining beef consumption?
 - Demand for reliable products
 - fillet and mince?
- Not unique to European beef!
- Not a new problem

What has been done?

What can be done?



European Environment Agency: www.eea.europa.eu

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Industry Priorities



SUSTAINABLE BEEF QUALITY FOR EUROPE

**A Workshop for
Industry & Scientists**

Milan, October 2015

How can Europe get the
best value out of its beef?

What needs to be done to ensure
sustainability of the European beef industry
over the next 10 years?

Farmer et al., Viandes et Produits Carnes, 2016



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Industry Priorities



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Eating Quality

- Reduce inconsistency
- Methods to monitor eating quality
- Identify cost of unacceptable quality

Nutritional quality

- Better knowledge of nutritional benefits

Consumers

- Greater communication with consumers (esp. nutrition)
- Greater understanding of consumers
- Halt the decline in consumption

Production

- Greater efficiency at farm level

Farmer et al., Viandes et Produits Carnes, 2016



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Beef quality assurance

- **Beef classification schemes**
 - To describe beef to distant buyers and sellers:
 - carcass weight, age/maturity, sex, fat cover/colour, conformation, freedom from bruising ...
- **Beef grading**
 - To place different values on carcasses for pricing purposes
 - USDA, EUROP & fat class
- **Farm quality assurance schemes**
 - To QA production systems, animal welfare, traceability ...
 - Red tractor, Label Rouge, Farm Quality Assured (NI) ...
- **Eating quality grading**
 - To quality assure eating quality ...
 - UK Blueprint, USDA, MSA ...



AHDB, 2008; Polkinghorne & Thompson 2010

Beef eating quality systems

Summary of classifications

Grades	System			
	MLC	USDA	NZ QMark	MSA
Outside system	Ungraded	Ungraded	Ungraded	Ungraded / failed
Graded as unsatisfactory		Utility Commercial		Unsatisfactory
Graded as satisfactory or good	Blueprint “Blueprint plus” (~21d ageing)	Standard (x3) Select (x2) Choice (x3) Prime (x3)	QMark	3* 4* 5*
Grade applied to:	<i>whole carcass (selected premium cuts)</i>	<i>whole carcass (cuts not specified)</i>	<i>whole carcass (selected premium cuts)</i>	<i>each cut / ageing period / cooking method</i>

Beef eating quality systems

Main factors

MLC

Age
Maturity (teeth)
Fat cover
Fat class
Hanging method
Chill regime
Meat and fat colour
pHu
EUROP Grade
Ageing (Bulls)

USDA

Maturity (oss.)
Marbling
Visible meat
texture &
colour

NZ QMark

Age (teeth)
Transport/mixing/
lairage
pH/temp. decline
Electrical
stimulation
pHu
Shear force

MSA

Breed (Brahman)
Maturity (oss.)
Fat cover
Marbling
Transport/mixing/lairage
pH/temp. decline
Meat & fat colour
pHu
Hanging method
Electrical stimulation
Ageing
Cut/muscle
Cooking method

Statistical evaluation of how well these factors predict consumer satisfaction

How well do systems differentiate consumer satisfaction?

	MLC	MLC omitting conform'n	US- Grade	NZ- QMark	MSA- AU	MSA +Bulls
Grilled steak						
Striploin – anterior (STR045-A)	✓	✓	X	X	✓	✓
Striploin – mid (STR045-M)	X	X	✓✓	✓	X	X
Striploin – posterior (STR045-P)	✓	✓	✓	✓	✓	✓
Rump cap (RMP005)	X	X	X	✓	✓	✓
Rump heart (RMP131)	✓	✓✓	✓	✓	✓	✓✓
Rump (RMP231)	✓	✓	✓	X	✓	✓✓
Total (grilled)	4	5	5	4	5	7
Roast beef						
Silverside eye (EYE075)	X	X	X	X	X	✓
Silverside (OUT005)	✓	✓	X	✓	✓	✓✓
Rump heart (RMP131)	X	X	XX	X	✓	✓
Rump (RMP231)	✓	✓✓	✓	✓	✓✓	✓✓
Topside (TOP073)	✓	✓✓	X	✓✓	✓	✓
Total (roasted)	3	5	1	4	5	7
Total	7	10	6	8	10	14

Comparison of beef eating quality systems

- None of the systems are perfect
 - Variability of “satisfactory graded” beef is reduced but not removed
- Best delivery of eating quality to consumers:
 - Best: Modification of MSA system
 - Possible: Modification of MLC system
- Best quantity of graded beef:
 - MSA systems would have graded ~80% of beef assessed
 - MLC Blueprint would have passed ~40% of beef




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Recent research

(Literature 2010-2016)

Pre-slaughter and post-slaughter factors

- Genetics, genomics, breed, diet, stress, processing, dry ageing, packaging, tenderisation ...



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Recent research

(Literature 2010-2016)

Managing eating quality

- Instrumental prediction:
 - VIA, MRI, CT scanning, NIR, HSI
- Grading for eating quality:
 - EUROP, USDA, Canadian - evaluation for eating quality
 - MSA or MSA-type systems



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Instrumental prediction

(Research 2010-2016)

- Moss et al., 2010 Hyperspectral Imaging (HSI)/ Raman spectroscopy
- Yancey et al., 2010 Visible & Near-Infrared spectroscopy (Vis-NIR)
- ElMasry et al., 2012 HSI
- Roehe et al., 2013 Robotic pH, VIA, CT scanning, ultrasonic fat depth, Vis-NIR, Raman, HSI

“Scottish programme for “Integrated Management of Eating Quality”

- Font-i-Furnols et al., 2014 Computed Tomography (CT) scanning
- Qiao et al., 2015 Visible Hyperspectral Imaging
- Peng & Dhakal 2015 Optical methods - review
- Lee et al., 2015 Magnetic Resonance Imaging (MRI)



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Instrumental prediction

(Research 2010-2016)

Composition

- **Robotic pH** - robotics work well but pH sensory technology needs improvement
- **VIA** - as good or better than manual grading for saleable meat and carcass fat
- **CT Scanning** - very good for composition, but expensive. Reference method.
- **MRI** - very good for IMF, but not an on-line procedure
- **HSI** - prediction for IMF: $R^2 \sim 70\%$
- **HSI** - variable prediction for fatty acid groups: $R^2 \sim 50-70\%$
- **HSI** - variable prediction of pH: $R^2 \sim 23-73\%$



Moss et al., 2010; ElMasry et al., 2012; Roehe et al., 2013; Lee et al., 2015; Qiao et al., 2015

Instrumental prediction

(Research 2010-2016)

Eating Quality

- **Vis-NIR Spectroscopy -**

- Predicts Shear Force (SSF): $R^2 = 9-50\%$ (dep. days post sl.)
- Predicts tenderness: $R^2 = 7-46\%$ (dep. muscle)

- **HSI -**

- Predicts Shear Force (SSF/WBSF): $R^2 = 20-83\%$ (dep. days post sl. & muscle)
- Predicts tenderness: $R^2 = 7-50\%$ (dep. muscle, lab, ?)
- Predicts flavour: $R^2 = 32-50\%$ (dep. muscle, lab, ?)

Moss et al., 2010; ElMasry et al., 2012; Roehe et al., 2013; Qiao et al., 2015

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Grading for Eating Quality

(Research 2010-2016)



USDA, Canada, EUROP

- **USDA** - large grade differences are detected by consumers but not lesser ones
(Tedford 2014; Acheson et al., 2014; O'Quinn et al., 2015; Mateescu et al., 2016)
- **Canadian grades** did not differentiate on tenderness
(Puente et al., 2016)
- **European conformation and fat scores** have no relationship with eating quality
(Bonny et al., 2016)

Not designed to predict eating quality!

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Grading for Eating Quality

(Research 2010-2016)

MSA or MSA-type systems

- Effective for beef and consumers from
 - Australia, S Korea, S Africa, Japan, NI, ROI, France, Poland
- Adaptations
 - Inclusion of bulls, dairy, different regimes, cooking methods
 - Prediction of flavour quality and characteristics
- Joint European data analysed
 - Ossification better than age at predicting EQ
 - Dairy beef slightly better and bulls slightly poorer



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Grading for Eating Quality

Update on MSA or MSA-type systems world-wide

Australia

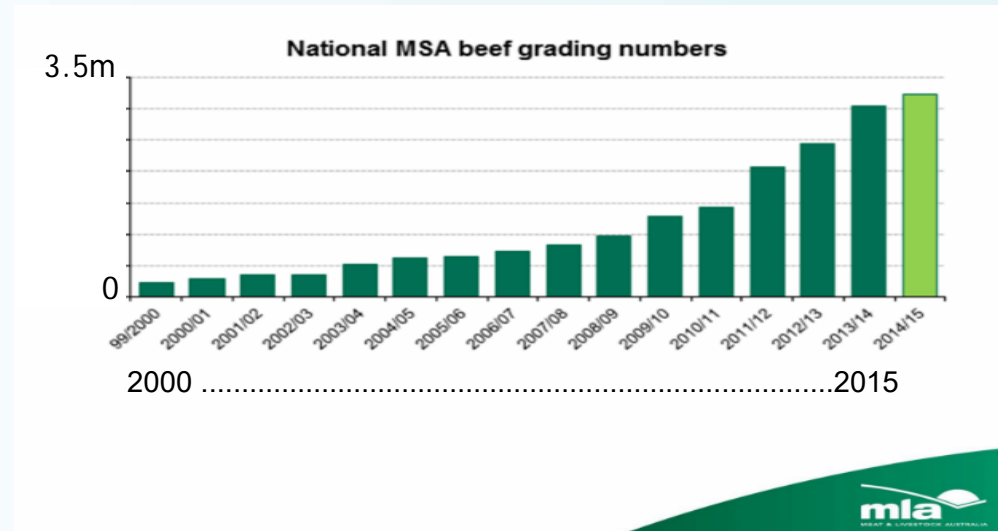
- 3.27 million carcasses 2015/16
- 38% of total Australian kill
- Now underpinning most brands
- Premiums est. at \$187m (~10%), 15/16

New Zealand

- MSA-type model > “Reserve Brand”
- Premium ~30% in NZ
- Launched ranges in Germany, USA +

Poland

- Polish Beef Association - Polish model developed



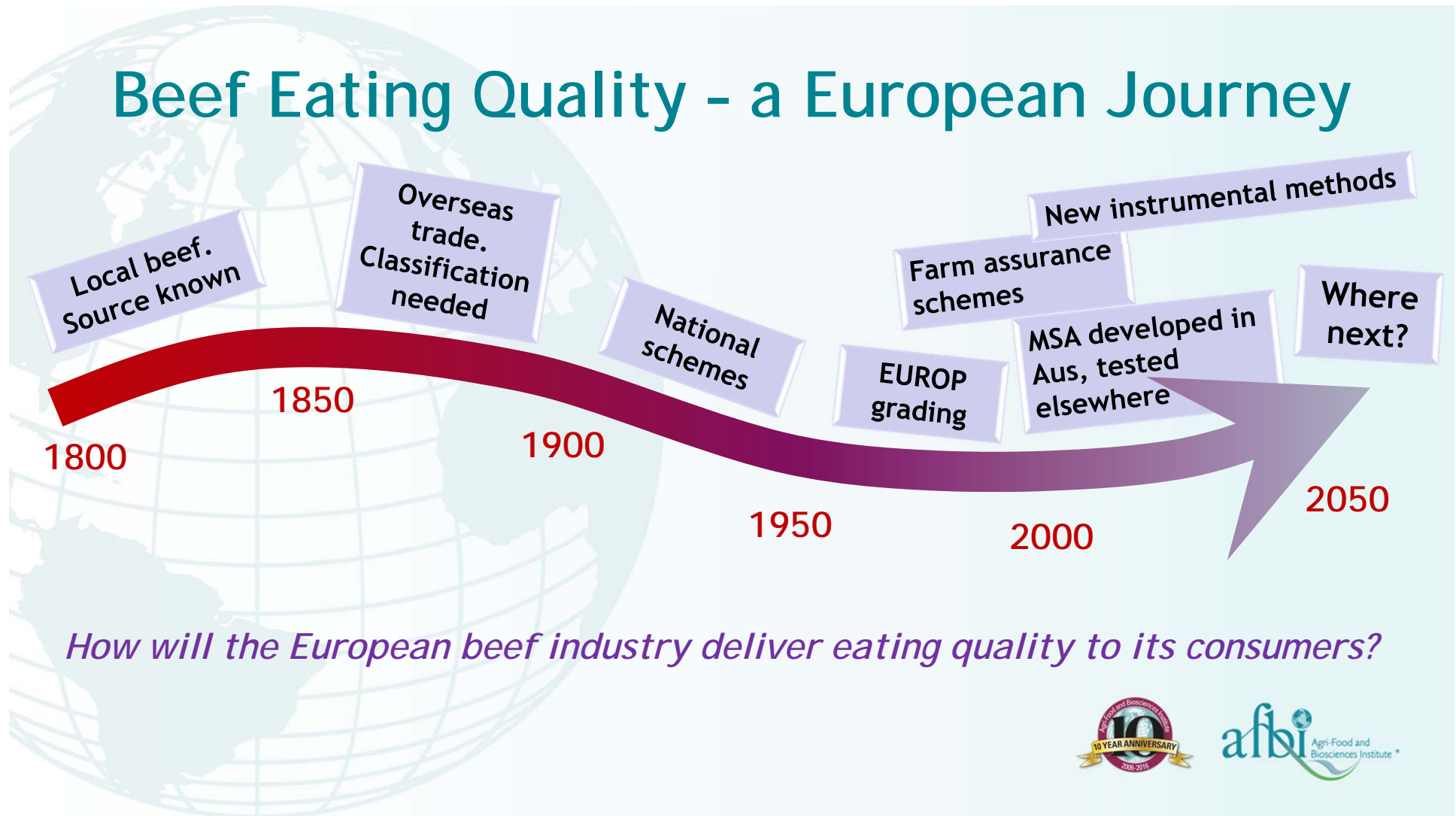
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How will the European beef industry deliver eating quality to its consumers?



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Current initiatives

Poland

- Industry is creating a Polish model

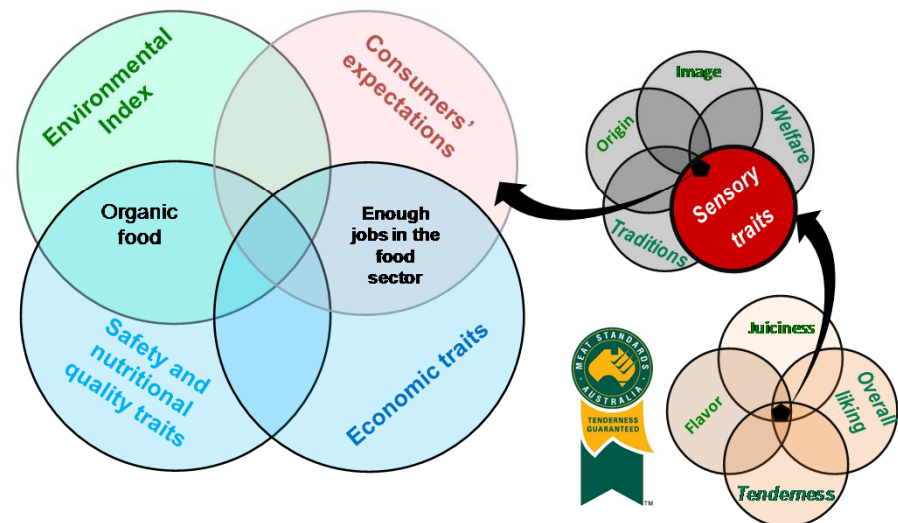
Possible EU project

- "3G" : Global Guaranteed Grading
- Integrated system

EuroBeef

- To harness work to date to create tools
- To meet needs of European beef industry
- To bring science and industry together

Towards a sustainable production of food?



INRA

Adapted from Fouquery-Mérel, Paré, Fosse, DGAL, 2014
and Botreau, INRA, 2014

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Where next?

Options

1. Continue with retailer/company specs?

- Is it delivering the consistency needed?

2. Meat Standards Australia

- Industry is cautious - license fee, complexity, downgraded product

3. Instrumental monitoring on-line

- Advances in robotics but technology is not yet fully in place

4. New Eating Quality Assurance method?

- What would it need to deliver?



A new Europe-based Beef Eating Quality System?

Profitable

Commercially viable

Simple

at point of operation

Effective

Delivers better eating
quality to consumers



Flexible

To support:

- existing and new brands
- commodity and niche products
- new technologies
- environmental/welfare?

Different interpretations
for different companies