Genomic selection: from innovation to application

Donagh & Francis

Project team

- **Dawn Howard *(Teagasc)***
- **Sinead Waters *(Teagasc)***
- **Emma Finlay *(Trinity College Dublin)***
- **Francis Kearney *(ICBF)***
- **Donagh Berry *(Teagasc)***
- **ICBF team**
- **Industry *(National and international)***

Introduction

- Current methods of genetic evaluation based on statistical analysis of performance data
- Takes time for a bull to generate sufficient daughters to achieve high reliability
- High reliability rarely possible in cows

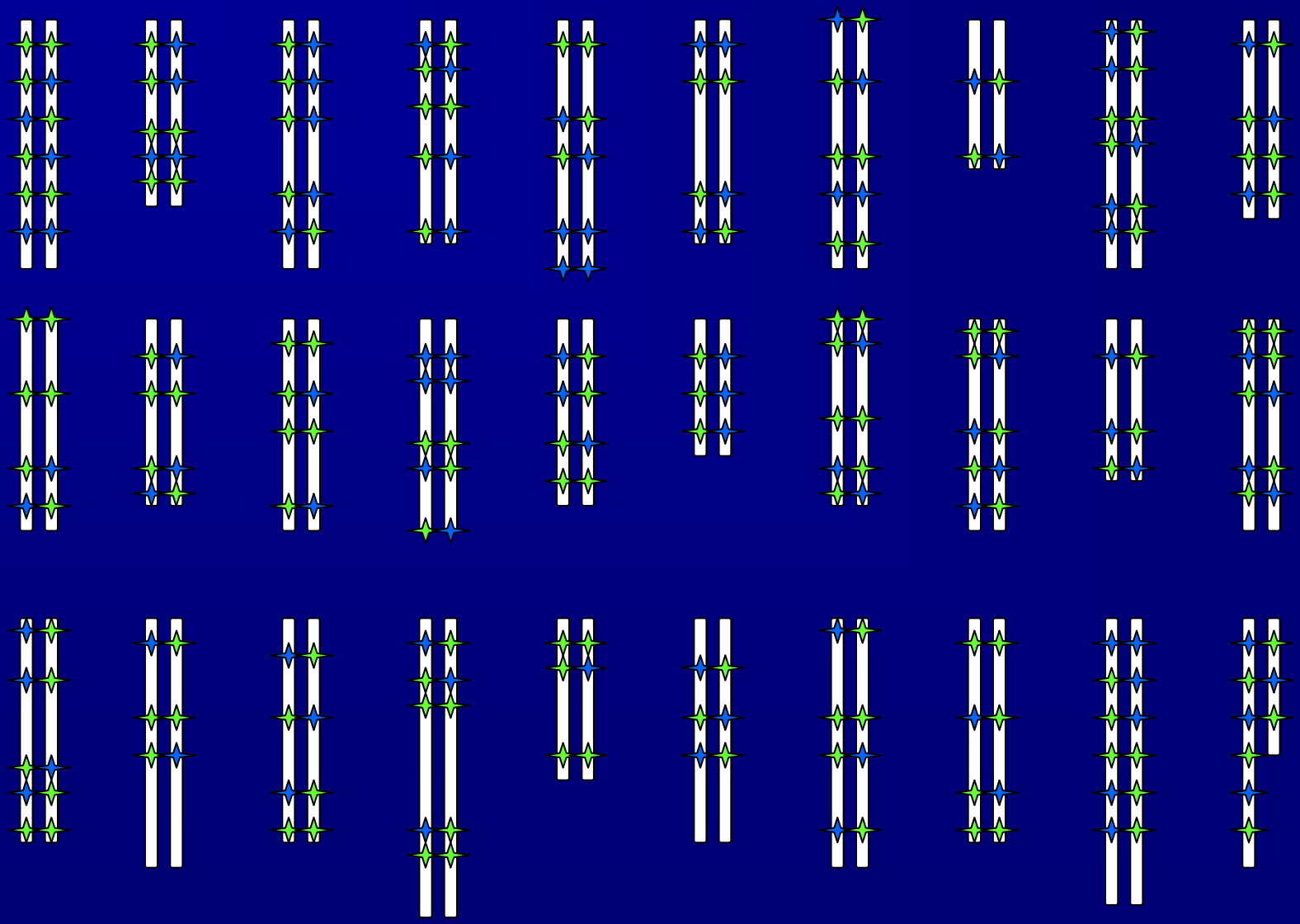
- We need to accurately identify the best animals at a young age

Genomic selection

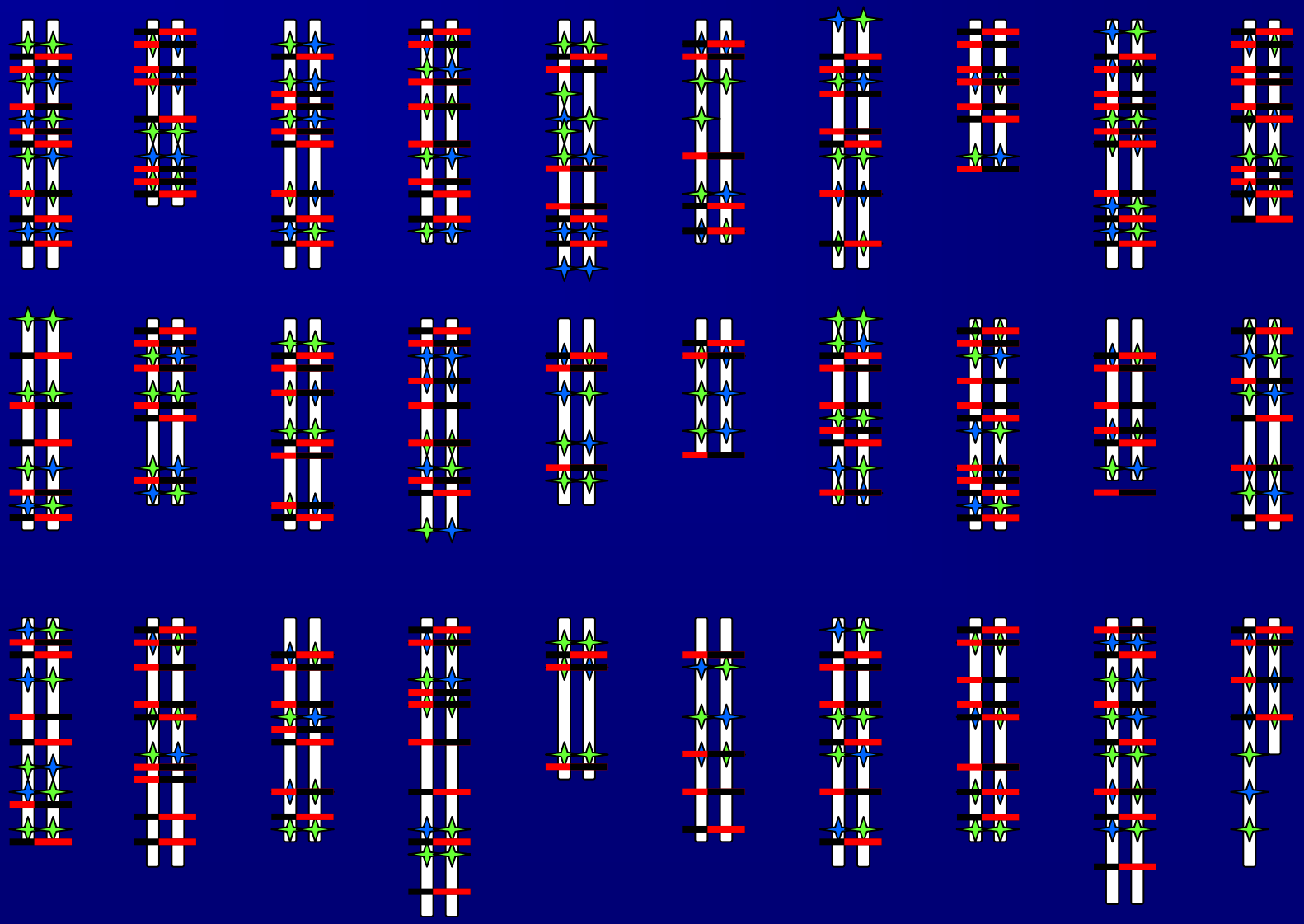
"..most promising application of molecular genetics in livestock production since work began almost 20 years ago"

Sellner et al., (2007)

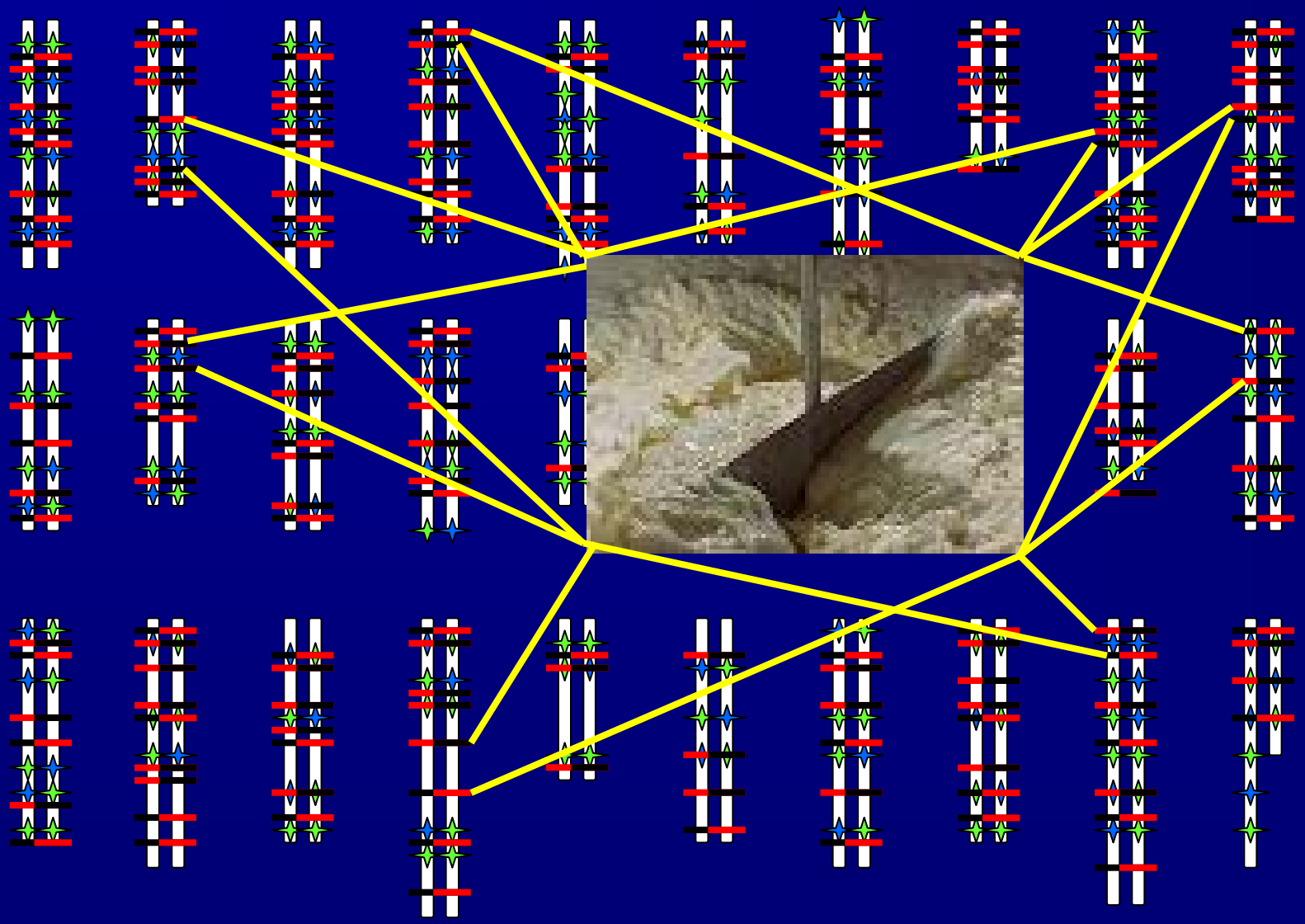
Theory of Genomic Selection



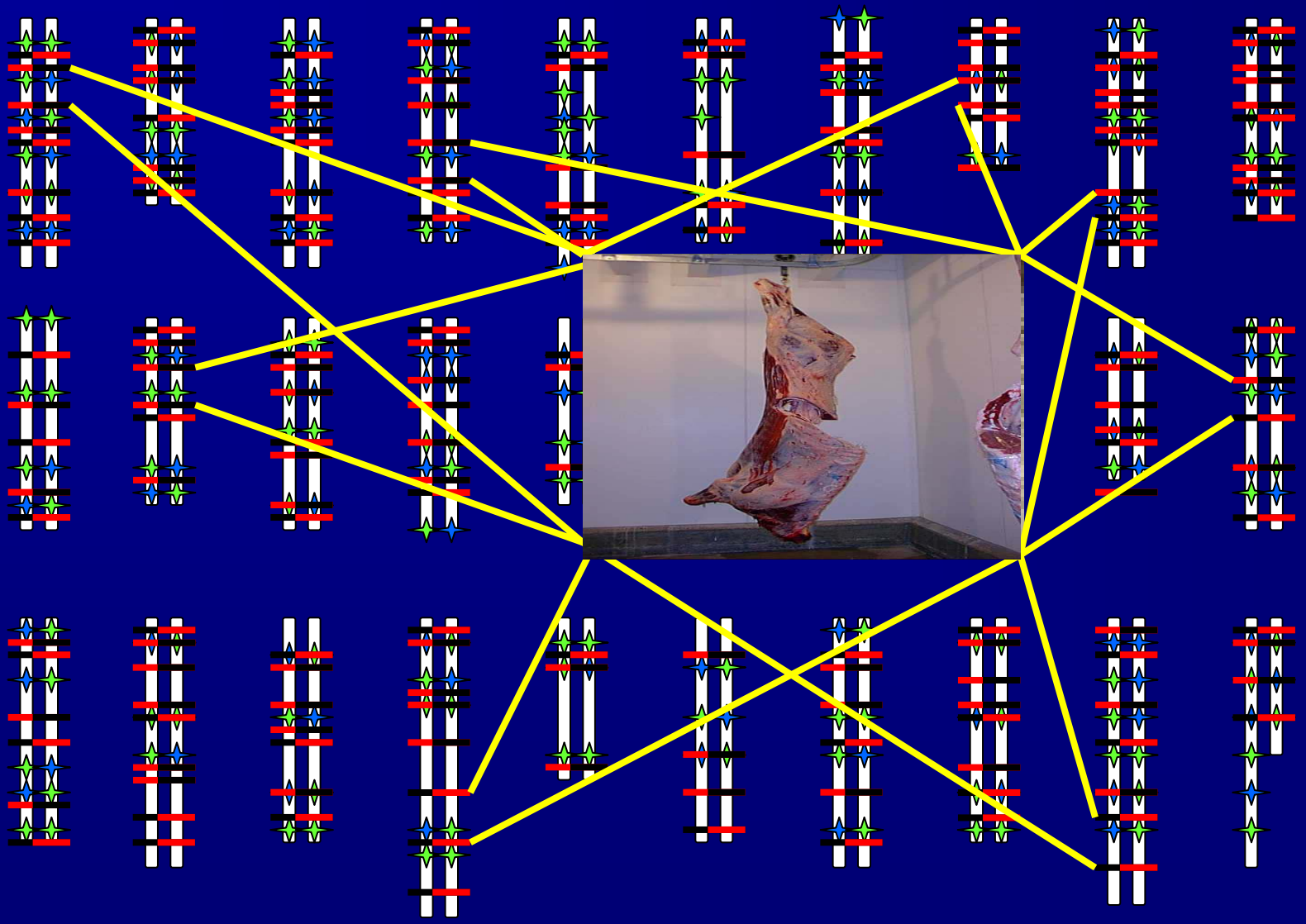
Theory of Genomic Selection



Theory of Genomic Selection



Theory of Genomic Selection



The obstacle

What is the best "DNA signature"?

The process

Collected biological material ***(Stimulus & NCBC & ICBF)***

DNA extracted ***(Stimulus & Teagasc)***

Genotyping ***(AROS, Denmark - Stimulus & Teagasc & NCBC)***

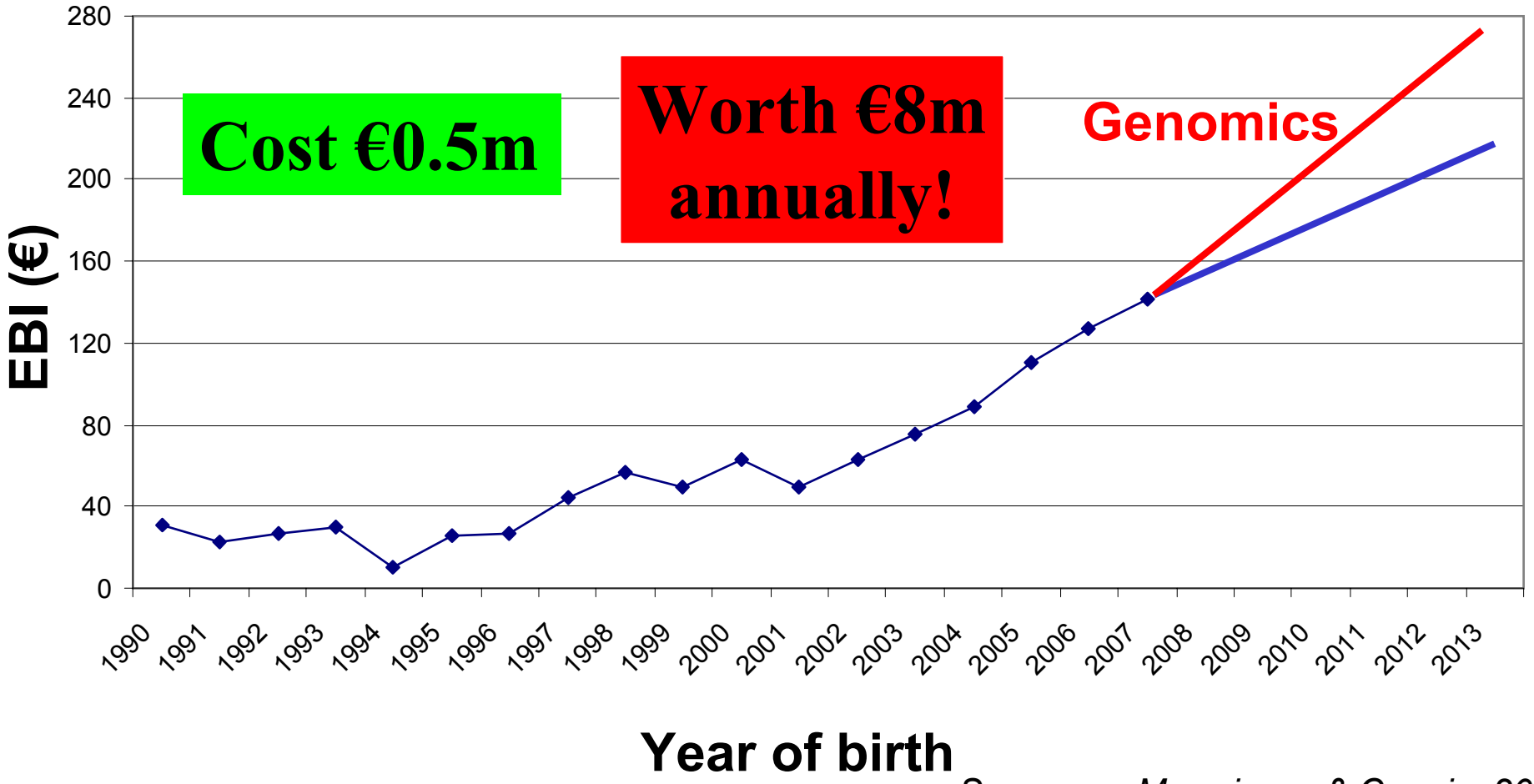
Software development ***(Teagasc)***

Industry consultation
International collaboration

Implement ***(ICBF & Teagasc)***

Application ***(National and International Breeding Organisations)***

Effect on genetic gain



Sonesson, Meuwissen & Cromie, 2008

Why was development successful?

- **Industry Driven!**

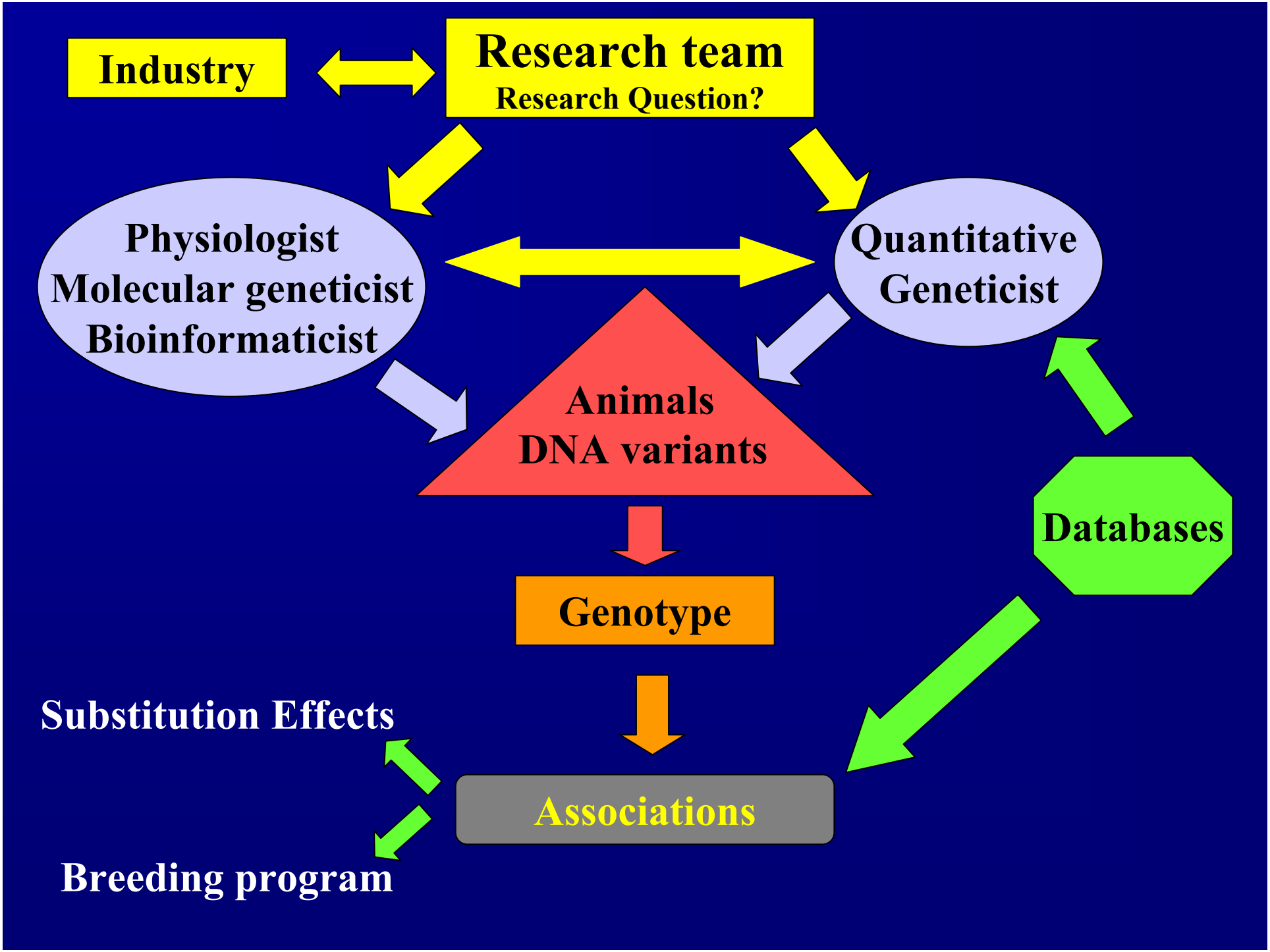
- **Strong Collaboration: Teagasc, ICBF, Industry**
- **Key Resources available:**
  - **Scientific capabilities**
  - **ICBF database plus Gene Ireland Breeding Programme**
  - **Financial support- DAFF Stimulus Funding, Teagasc**
- **Excellent communication**

International recognition

- Ireland is the second country in the world to release genomic breeding values (after US)
- Invited speakers to international conference
- Initiating international collaborative efforts
- International software development consortium (http://www.genomicselection.net)
- 1 FP7 collaborative project (http://www.robustmilk.com)
- 1 FP7 Marie Curie network (GREENHOUSEMILK)

Future research priorities

1. Genomic selection
   - Smaller chip ← massive role for collaborative research among production scientists, quantitative geneticists, and scientists in system biology
   - Other breeds/species
2. Definition of novel phenotypes
   - Fertility
   - Health
   - Feed efficiency
3. Breeding program design


Industry
Research team
Research Question?
Physiologist
Molecular geneticist
Bioinformaticist
Quantitative
Geneticist
Animals
DNA variants
Databases
Genotype
Substitution Effects
Associations
Breeding program

Work in Progress

- Scientists at Teagasc, UCD & ICBF

- DGAT1
- 77 kg milk, -4.2 kg fat, 0.99 kg protein
- 4.5% of genetic variance in milk yield
- 10% of genetic variance in fat yield
- 0.6% genetic variance in protein yield

- Other genes under investigation

Conclusions

- **Ireland is probably in one of the strongest positions in the world to exploit this technology for the Irish Agri-Food industry**

Acknowledgements

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- **Teagasc**
- **ICBF**
- **Industry**