Welcome to DuPont Pioneer

Fast and Reliable Prediction of Corn Energy Value for Swine Diets

- Grain & Nutritional Sciences
- Overview of NIR
- Genesis of the Prediction Model

The Long Look

Written in 1952, the Long Look continues to define our business principles despite the many changes Pioneer has gone through over the years. We strive to live by it every day.

We earn our customers' business by striving to:

- Develop the best products possible
- Deal honestly and fairly with our business partners
- Advertise and sell our products vigorously, but without misrepresentation
- Provide management suggestions that help customers derive the greatest possible value

Services

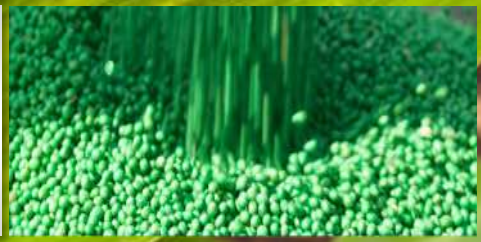
We offer support above and beyond the sale with:

- Agronomic Services
- Precision Agriculture
- Risk Management
- Financial Support
- End-user Support

Encirca℠ Services

Animal Nutrition

Seed Treatment



Crop Protection

Grain & Nutritional Sciences Group (GNS)

- **Characterize grain, forage and microbial inoculant products to support product advancement and commercialization**
  - High-throughput sample analyses
  - Reference (wet) chemistry
  - Microbial inoculant prototype testing
  - Animal trials (performance, digestion)
  - Feedmill

- **Develop NIR models to support research and sales activities**

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Near Infra-Red (NIR) Spectroscopy Overview

A Versatile Spectroscopic Analytical Tool

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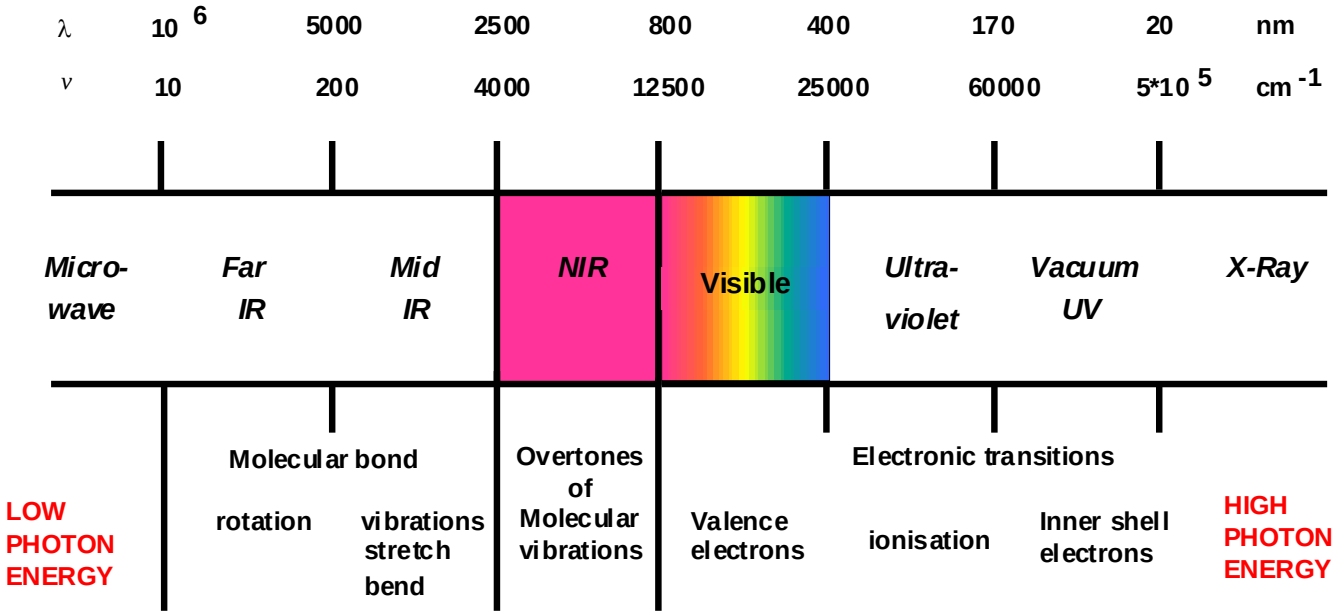
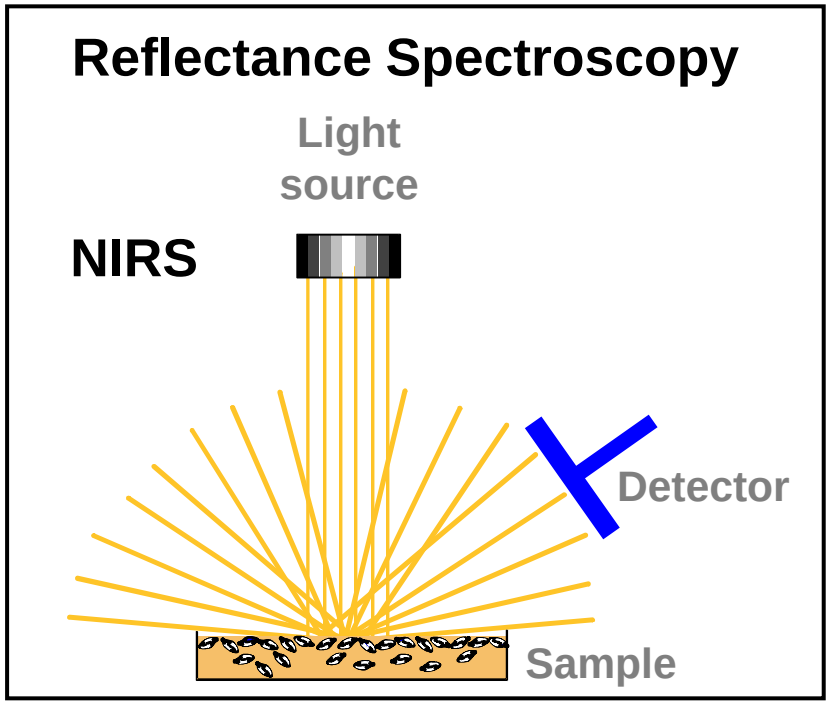
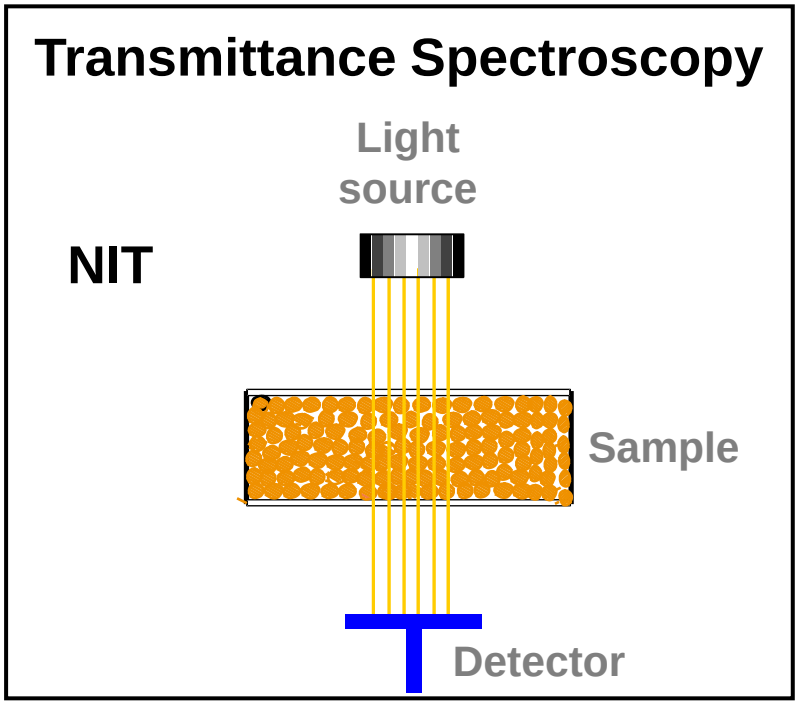
The Electromagnetic Spectrum

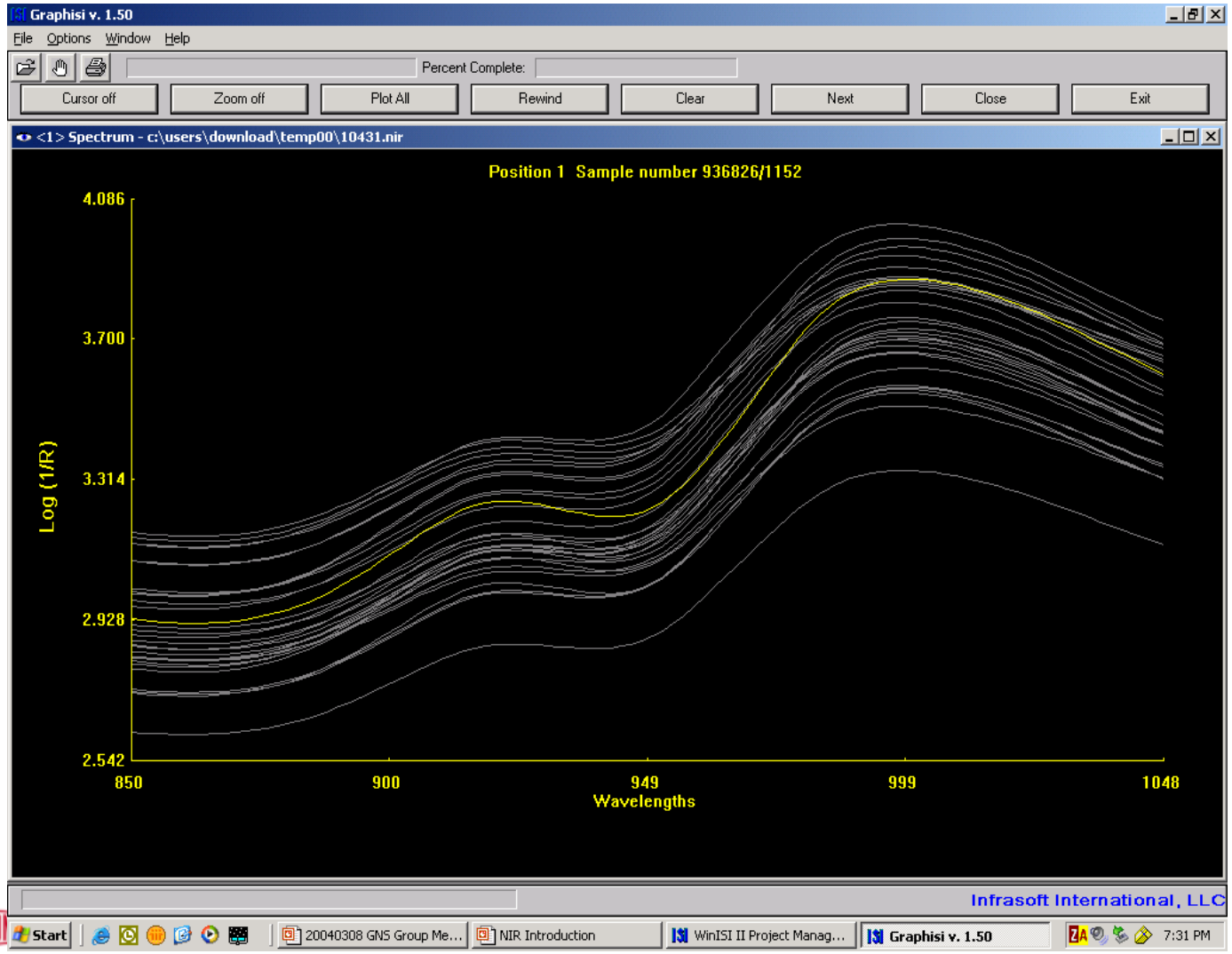


Analytical Principle of NIR





Sample Spectrum



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Advantages of NIR Spectroscopy

- Rapid
- Can be non-destructive
- Multi-component Analysis
- Requires little (or no) sample preparation
- Accurate and reproducible results

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Limitations of NIR Spectroscopy

- A “secondary” technique so it is only as good as the primary analytical/method
- NOT a trace analytical technique (<0.1%)
- Limited spectral range: 850-1050 nm
- Complex chemometric routines: PLS, ANN
- Model development is NOT trivial

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Reference Chemistry

- Provides “true” (referee) values for model development and validation
- On-going model validation
- Can be highly variable
  - Animal trials vs analytical equipment
  - Covariate adjustment of data often needed

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Steps to Building a Calibration Model

- Scan Samples - Record NIR Spectra (80-100 min)
- Develop *Representative* Calibration Database
- Perform *Reference Analyses* on Calibration Database
- Combine Reference Results with Calibration Database (Chemometrics, Complex Mathematical Modelling)
- Build Calibration Model
- Validate Model
- Predict Unknown Samples with Model

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Model Expansion: Sample Selection Criteria

- Update models when sample matrix (hybrid), raw materials or process changes
- Expand Each Constituent Concentration Range
- Avoid Redundancy
- Fill n-Dimensional Spectral Space (hybrids, locations, growing conditions, etc.)

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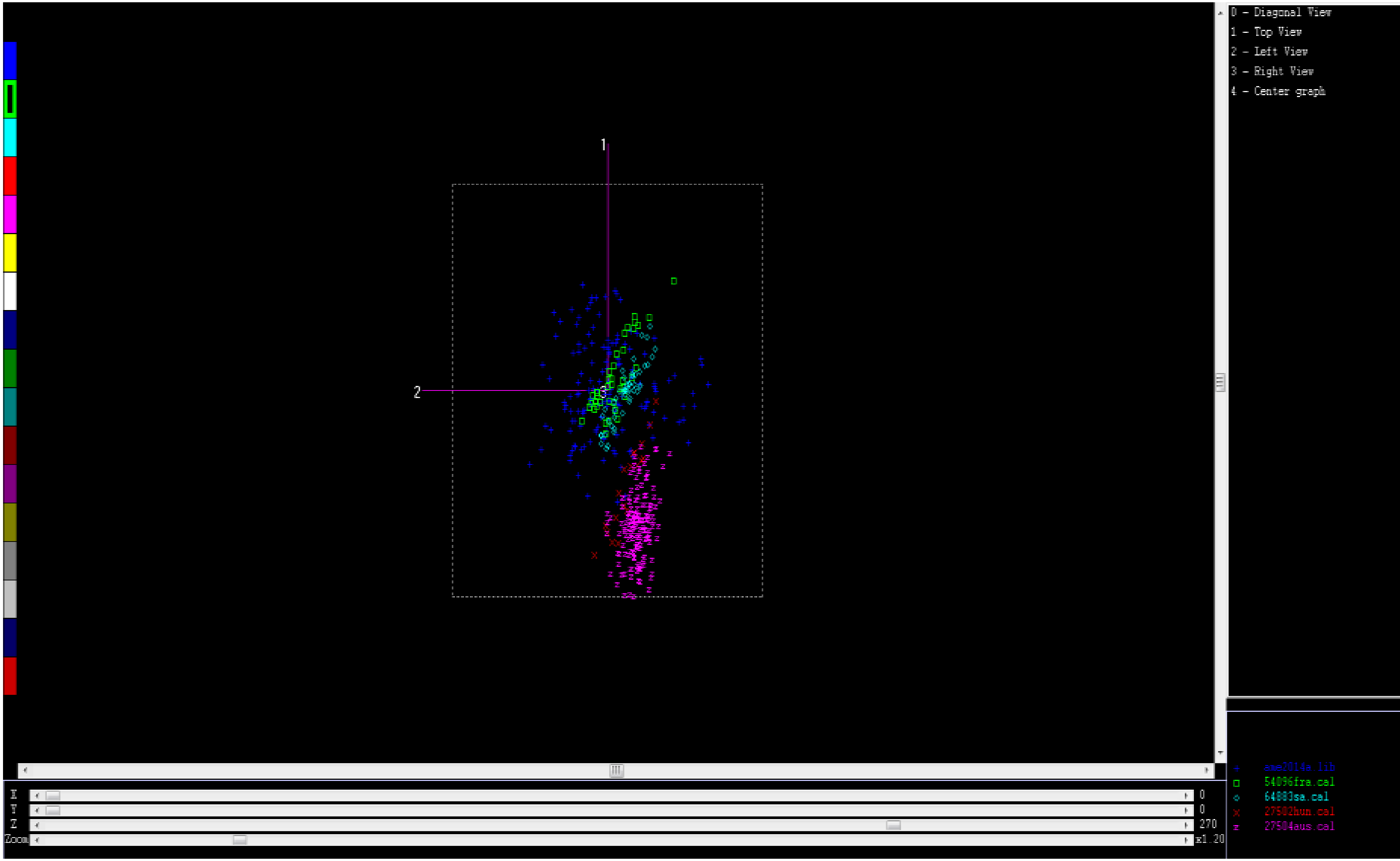
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2 – Left View
3 – Right View
4 – Center graph
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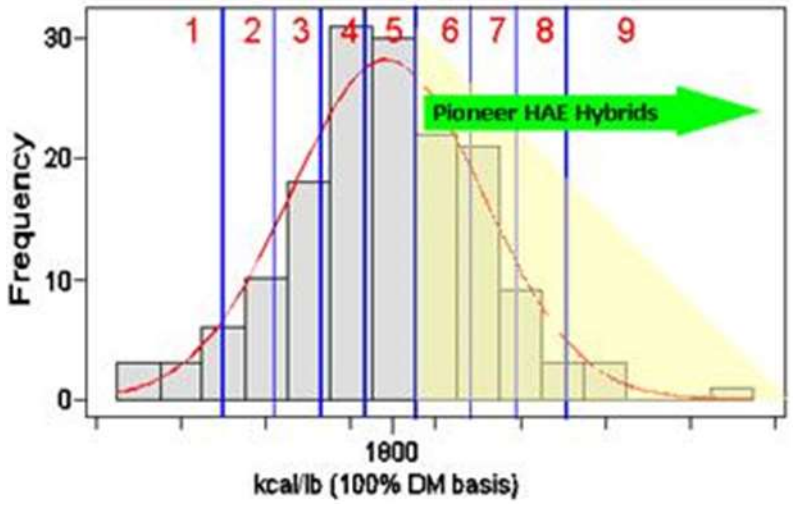
What is HAE?

Nutritional Characterization that Predicts the Swine DE for Corn Hybrid Platforms



Why is HAE Important?

Pioneer Research Has Discovered:

Significant Variation in
Energy Content of Corn Grain

Strong Genetic Component

Developed Methods to Characterize This Trait

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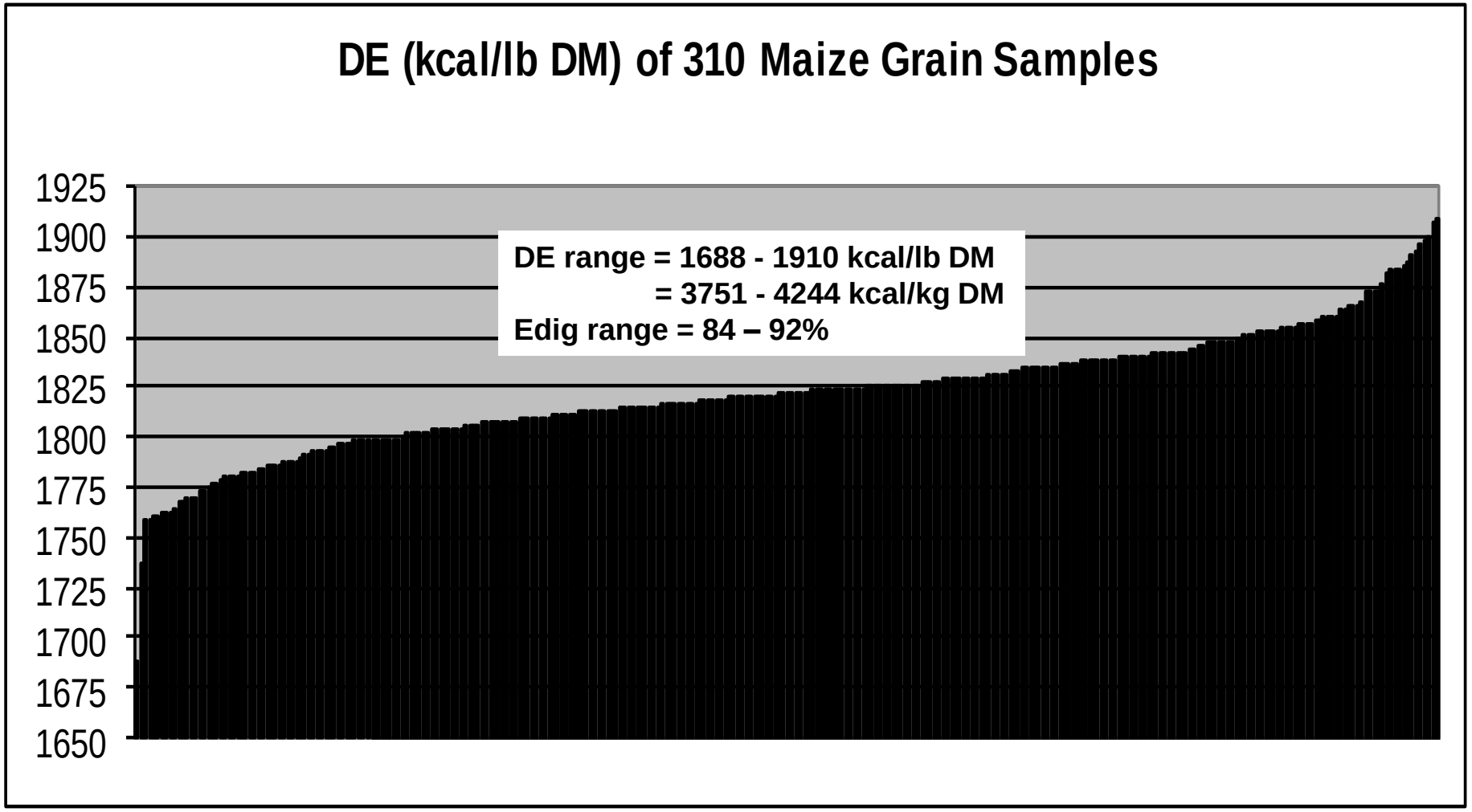
Range in DE in grain from commercial hybrids



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How Was HAE Originally Developed

- Pioneer Livestock Nutrition Center
  - 36 Stainless Steel Swine Metabolism Pens
  - 18 Pens in Each of 2 Rooms
  - Temperatures Maintained at 70° ± 5° F
  - Grinding and Mixing Equipment
  - Facilities for Sample Drying and Preparation

- Grain Quality Lab (Urbandale, IA)
  - In-house Lab for Bomb Calorimetry and Dry Matter

Improvements/Updates

- Wanted more precision
- Fed same set of samples to broilers and roosters
- Realized we could make improvement with AMEn
- Precision feeding trials at AHPharma
  - 21-day old chicks raised on site
  - Single room with several battery units
  - Each unit holding an equal number of cages
  - Equal number of males & females in each cage

- Utilize AMEn prediction to calculate swine DE

Journal of Animal Science 93:1025-1038

Published February 27, 2015

Predicting the digestible energy of corn determined with growing swine from nutrient composition and cross-species measurements

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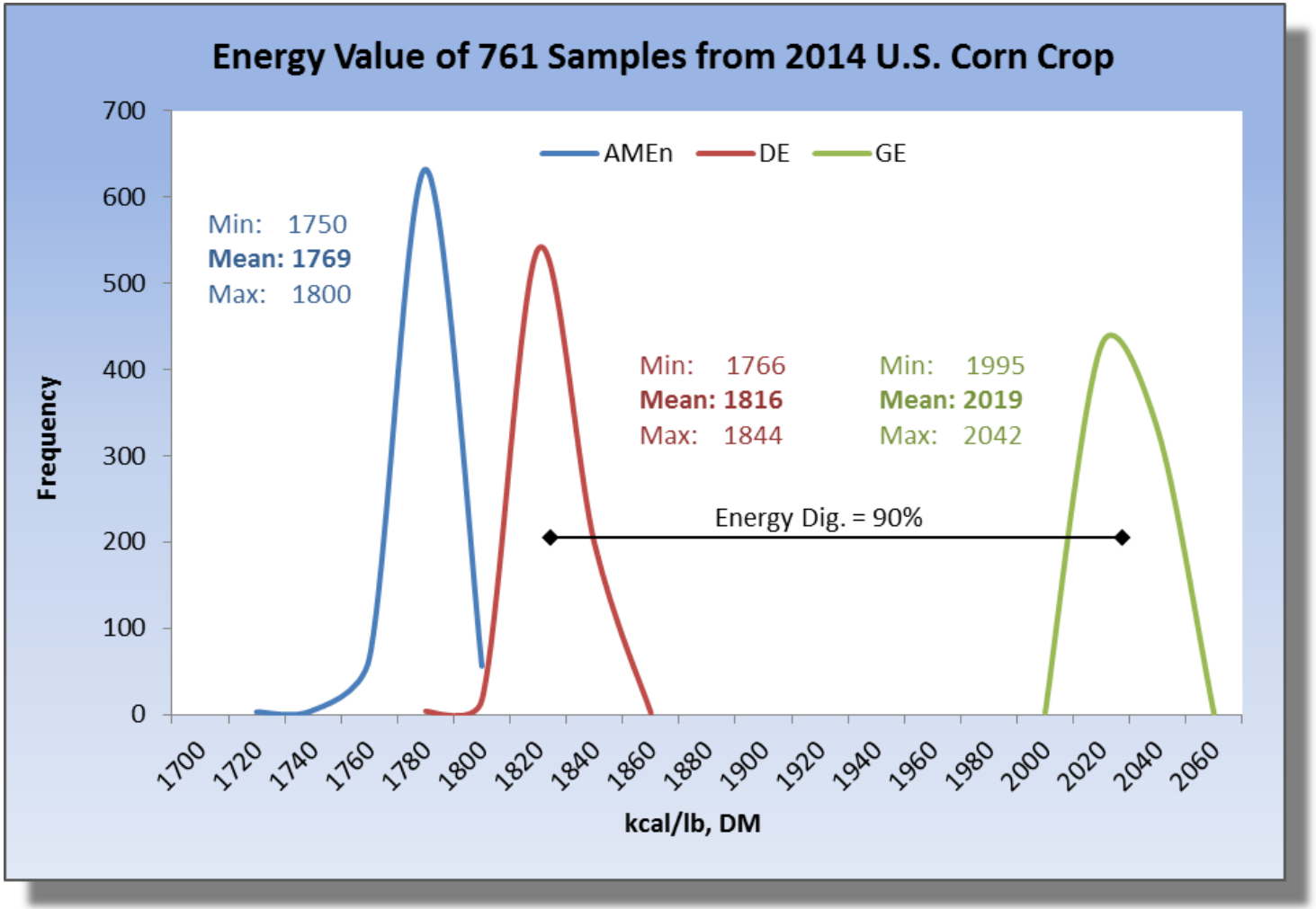
Summary from Danisco Service Offering



Summary

- Mid-90's Pioneer had interest in understanding germplasm differences of value to livestock, in this case swine.
- In 2003, Pioneer developed a proprietary way of predicting, in a high-throughput fashion utilizing NIT technology, the amount of energy from maize grain that is available to pigs and poultry.
- Pioneer originally developed this capability for North American germplasm using swine feeding studies.
- In 2012, we converted to a more precise animal model (poultry AMEn) and found the need to incorporate Worldwide germplasm.
- Important to maintain tight control of process: grain processing, animal feeding and material collection
  - Our NIT prediction model will be no better than the reference method (data generated by the AMEn trial)