PROMOTING INNOVATION THROUGH COOPERATION

Wayne Powell
Principal and Chief Executive
The state of the world in 1920 - 1950
The state of the world in 1950

- No knowledge of DNA
- No widespread use of antibiotics
- Few co-ordinated vaccination programs
- Serious threats from smallpox, polio, whooping cough, diptheria, and syphilis
- Little international co-ordination for scientific research
- Only the most primitive of computers
- Cost of oil (inflation-adjusted): $26/barrel
- No space travel, no satellites
- No contraceptive pill
Now easy to edit the genomes of crops, animals and humans
Expectations of Funders & Society have changed

- No longer funders but **INVESTORS**!
- Emergence of new **DISRUPTIVE TECHNOLOGIES**
- Research **DELIVERING** economic and social benefits
- More Strategic & Collaborative to create added value and accelerate impact
Innovation is not just about a few people in labs making breakthroughs, but about adopting new and more productive ways of working.

We must become a more innovative economy and do more to commercialise our world leading science base.

Building a new system of technical education boosting STEM skills, digital skills and numeracy.
The Need for Innovation & Leadership
Innovation-Learning-Audacity & Team work
SRUC in numbers

- **6** Campuses
- **8** Disease Surveillance Centres
- **25** Consultancy Offices
- **1,300** Staff
- **180** Researchers
- **126** Consultants
- **24** Vets
- **96** Scientific Staff
- **7** Farms (over 4,170ha)
- **848** FE Students
- **1,516** HE Students
- **125** Distance Learning Students
- **98** Research Post Grad Students
- **2,000** Attendees on short courses
- **7,800** Farmer Subscribers
- **£77.1m** Turnover
- **18,000** Customers

Research classed as “**World leading**” (REF grading of four star) or “**Internationally Excellent**” (three star)
Maximise & Harness the use of Scarce Resources through new Relationships & Partnerships. Collaborative Partner of Choice
Co-location of SRUC Veterinary Services on Moredun Campus
National Science Capability for Animal Health

Increase Productivity & Competitiveness of Scotland’s Livestock Sector

- Best technology provided at one site
- Critical mass for each scientific team promoting professional development
- Interaction with scientists at MRI creates potential for faster scientific development in diagnostics

Pathology Teams

- Shared processing
- Diagnostic pathology team consists of SRUC and Moredun pathologists providing expertise

Diagnostic Virology

- Specialist techniques
- Test development

Surveillance supporting research supporting surveillance

- Cryptosporidia, Neospora, Johne’s disease, BVDV etc
Analysis of Pig Health Scheme Data

Pig Health Scheme
Healthy pigs for healthy profits
Innovative Use of Emerging Technologies to Improve Pig Production Efficiency – Scottish Pig Health Network (SPHN)

**AIM:**
To improve the efficiency and sustainability of the Scottish pig supply chain through control or elimination of production-limiting diseases by the innovative application of emerging technology to actively drive management changes on farm through a knowledge exchange network.

**Partnership:**
- Wholesome Pigs Scotland
- SRUC
- BVA Scotland
- Quality Meat Scotland

*Leading the way in Agriculture and Rural Research, Education and Consulting*
Animal welfare solutions need to be:

- based on an understanding of their impact on animals’ experiences
- relevant to public concerns
- cost-effective and practical
- sustainable/ integrated with other public agendas
Jos Houdijk, Head of Monogastric Science Research Centre; research interest in nutritional sensitivity of animal production, health, disease and environmental footprint:

Avian Science Research Centre

Mobile Sensory Lab

Mike Coffey, Team Leader; interest in helping farmers adapt new technologies

Feed Efficiency Feeders

Jenna Bowen, Scientist; specialising in techniques to assess between-animal variation in digestion of cattle; particularly potential links to feed efficiency

Respiration Chambers

Richard Dewhurst, Professor of Ruminant Nutrition & Production Systems and Head of Future Farming Systems Group
Internet of Things

- **LoRaWAN** (low frequency wide area radio network)
  - long range/low power communications platform
  - >10 miles range in rural areas
  - ideal for
    - deployment of sensors and devices where small amounts of data are transmitted periodically
    - when a given event occurs.

- **LoRa network**:  
  - established at SRUC Kirkton & Auchtertyre
  - covers most of the 2,200 ha of the upland research farms.
  - First LoRa network covering a remote, rural location in the UK and as such is a unique resource.
LoRaWAN™ network: potential use cases

- Array of soil temperature & moisture sensors: nutrient and grassland management
- Water turbidity/dissolved oxygen: alerts to pollution incidents
- Livestock tracking: alerts to off-farm movements
- Alerts to low levels in fuel/water storage tanks
- Tree growth & health
Scotland’s Land Use & Topology is Distinctive
Food & Feed for Alba

Technology Platform
Genomic prediction

Livestock and Aquaculture
(Nutrition for Scotland)

Pastoral Ruminant Agriculture

• EGenes
• Ruminants
• Microbiomes
• Langhill Herd

• Future Farming Systems
• Novel Crops
• Scottish Farmers’ Seed Network

New & Novel Products adapted to Scotland

• Waste
• Insects

Farm waste

Ligno-cellulose from timber and grasses

Seaweed

Circular Agri-Food Economy
High quality protein from grass

Ruminant x Plant x Microbe
Linking pastoral based systems to rumen microbiology & host genomics

Integrated analysis

(Meta)genome
Transcriptome
Proteome
Metabolome

‘Ruminant Microbiome’

Primary feeds

Improved feed

Trait selection

Low emissions

Microbial products for industry
Network of rumen microbial genes

Roehe et al. (2016) PLOS Genetics

Methane emissions

3970 microbial genes

20 genes explaining 81% of VAR in methane emissions
Microbial genes associated with FCE

49 microbial genes significantly associated with feed conversion ratio explaining 81% of the variation in model effects & 88% of the variation in FCE.

Microbial genes are related to known metabolic pathways, e.g. degradation of amino acids and proteins, protein and vitamin synthesis.
Selection using rumen microbial information

Sampling rumen fluid in the abattoir or live animals

Determination of the abundance of microbial genes
- 49 genes $R^2 = 0.88$
- 20 genes $R^2 = 0.81$
- $X$ genes $R^2 = ???$

Prediction of feed efficiency
- EBV FCE

Prediction of methane emission
- EBV CH$_4$

Prediction of animal health
- EBV Health
Genomic Selection: an unifying theme

De-coupling selection from phenotyping

\[ f(\theta \mid y) = \frac{f(y \mid \theta) g(\theta)}{p(y)} = \int f(y \mid \theta) g(\theta) d\theta \]
Scottish Farmers’ Breeders Network
A Sustainable Protein Source

FOOD & AGRICULTURAL WASTE

INSECT PROTEIN

FEEDS LIVESTOCK

150x space efficiency of soy
SRUC & Beta Bugs Synergies

Excellence in breeding

Expertise in monogastric nutrition

SRUC diversification & strategic roadmap

Building the first Insect Breeding company.

Creating breeds that meet feed producer needs

Growing partnerships that enable & bring value to Beta Bug’s efforts
SRUC - open for business

New ways of working

New investment opportunities

Time to be bold and audacious
Our Ambition

An enterprise university for Scotland’s Rural Economy

- Focussed on skills, jobs and business
- Serving the rural economy
- Regional presence and a lifetime guarantee to support skills development
- Driven by a culture of innovation and enterprise
The Need for Change: Agricultural Productivity Trends

TFP in Agriculture (2000 = 100)

Source: USDA Economic Research Service, Scottish Government
Primary Sector Productivity

Primary Sector GVA per Job - 2016

- Netherlands: € 64,169
- Sweden: € 50,091
- Norway: € 99,676
- New Zealand: € 45,489
- Scotland: € 30,331

Source: OECD, Scottish Parliament
Food and Drink Growth and Targets

Scotland's Food and Drink Sector (2007 - 2030)

Source: Scottish Government Growth Sector Database, Scotland Food and Drink Strategy: Ambition 2030
Food and Drink Growth Projections

Scotland's Food and Drink Sector (2007 - 2030)

Source: Scottish Government Growth Sector Database, Scotland Food and Drink Strategy: Ambition 2030

£5.6bn shortfall
R&D investment (agricultural and primary sectors)

Source: OECD, Includes BERD and GBARD, data for latest available year

### Primary Sector as % of Government & Business R&D

- United Kingdom: 1.2%
- Sweden: 4.2%
- Norway: 5.9%
- New Zealand: 13.5%
- Netherlands: 4.2%

### R&D Investment in Primary Sectors per Capita - 2015

- Netherlands: €30.51
- New Zealand: €26.49
- Norway: €53.37
- Sweden: €14.06
- United Kingdom: €6.65

Source: OECD, GBARD
Learning from the best in the world

SLU
SCIENCE AND EDUCATION FOR SUSTAINABLE LIFE

Lincoln University

NMBU Norway

Foodvalley
Shaping the Future of Food
Already within our grasp
Value Creation Model

- Strategic collaboration between Government, Industry and Expert Centres (research & education)

- Model replicated in agriculture across comparator countries
There is evidence of great success in the rural sector but we can do even better and lift the whole performance of the Scottish economy – a rural enterprise university is a key component of that vision.
Our Strategic Intent

A new Rural Enterprise University at the centre of a joined up Innovation Eco-System

Create a new University model that offers greater value and solutions to the challenges facing Scotland & the World.

Drive imaginative new ways of working and strategic collaboration that builds synergy, eliminates duplication and attracts new forms of investment.

A new Enterprise University at the heart of the rural economy. Delivering positive social, cultural and economic impact for Scotland. Is attractive to students, staff, collaborators and investors.
Thank You
Value Creation Model

- SRUC as the core driver of the rural economy & competitiveness of Scotland’s Food and Drink industry
  - Providing world-class translational research, education, skills training and consulting

- Leading innovation in Scotland’s rural sectors through the creation of an enterprise partnership with the Expert Centres (MRPs)
  - Business focussed capacity & capability that bridges and accelerates research & technology commercialisation
  - Shaping & delivering economic, skills and training strategies

- Built on a ‘Fraunhofer model’ approach to funding/investment
Across Agri-Food there are productivity gaps between Scotland and its comparator nations.

- The productivity gap is explained in part by the gap in R&D investment.

Comparator countries have Agri-Food universities, which drive innovation, translation and economic growth in these sectors.

- The innovation systems around these universities are just as important as the level of R&D investment.

There are significant economic and environmental benefits that can be gained by putting systems in place to match comparators.

- The prize is an additional £4.5 billion GVA in the primary sectors, meeting the targets for growth in food and drink and leading the world in reducing agricultural emissions.

Key points

There is evidence of great success in the rural sector but we can do even better and lift the whole performance of the Scottish economy – a rural enterprise university is a key component of that vision.
An Enterprise University for Scotland’s rural economy

**BENEFITS FOR SCOTLAND:** positive social, cultural & economic vitality

**Education**
- Universal learning - open to all socio-economic backgrounds that includes lifelong intelligent tutoring
- Connecting education & vocational skills with knowledge generation & innovation.

**Innovation**
- Driver of the competitiveness & productivity of Scotland’s Food & Drink industry
- Agri-Food-Health at Centre of a Circular Knowledge based Economy

**Rural Economy**
- Natural capital as the catalyst for the fusion of the green and blue economies.
- Anchor Institutional that supports both regional and global economic growth
- Focus on the SDGs as a global expression of sustainability

**ENABLERS**
- Cultural Change
- Knowledge entrepreneurs
- New operating model that is outward facing and less bureaucratic
- Reimagining strategic collaborations & leading new ways of working
- Diverse sources of investment