North East Scotland Agricultural Advisory Group (NESAAG) meeting
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The Internet of Agricultural Things (IoAT): a potential game-changer for farming in upland areas

Professor Davy McCracken

Head of SRUC's Hill & Mountain Research Centre

davy.mccracken@sruc.ac.uk

https://twitter.com/DavyMcCracken






Leading the way in Agriculture and Rural Research, Education and Consulting

Innovation = Doing Things Differently

Inbye grasslands
- *Soil pH and nutrients*
- *GHG emissions*
- *Grassland management*
- *Forage & fodder improvements*

Hill grazing
- *Bracken control*
- *Improving hill parks*

Sheep Performance
- *Genetic selections*
- *Blackface and Lleyn*

Flock Performance
- *EID associated kit*
- *TST worming of lambs*
- *Comparison of system trade-offs*

Auchtertyre flock
- *Restocking*
- *Blackloss*
- *Yellowses/Plochteach*

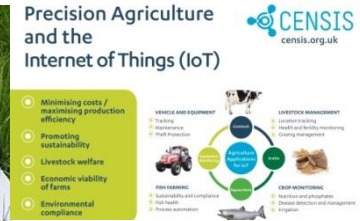
Technology
- *Virtual fencing*
- *Drones for assessments*

LoRa network
- *Tracking livestock*
- *Sensors*

Systems approach to Precision Livestock Farming

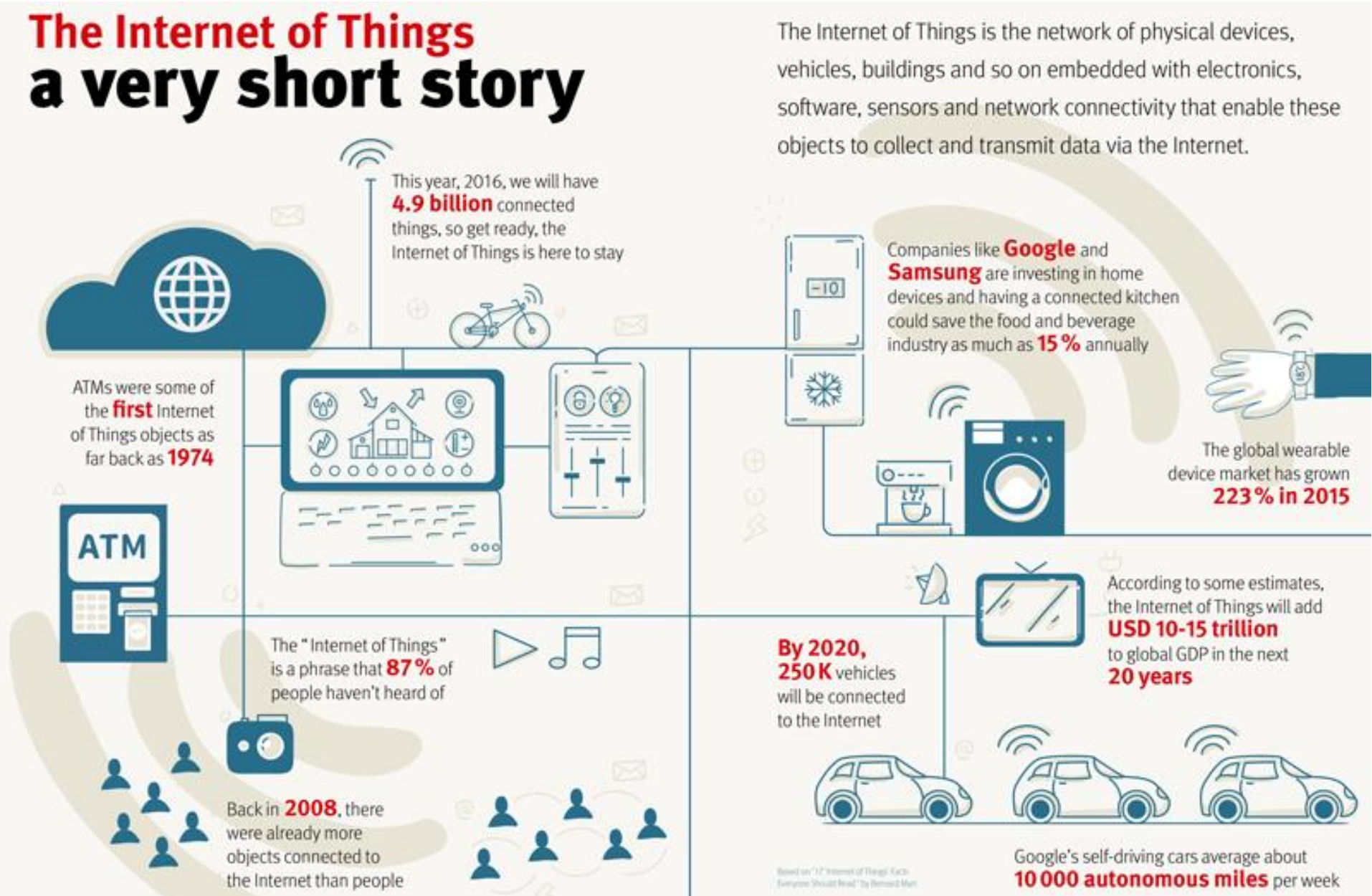




IoT: The Internet of Things

https://www.iso.org/files/live/sites/isoorg/files/archive/Ref2112/ref2112_infography_iot.png



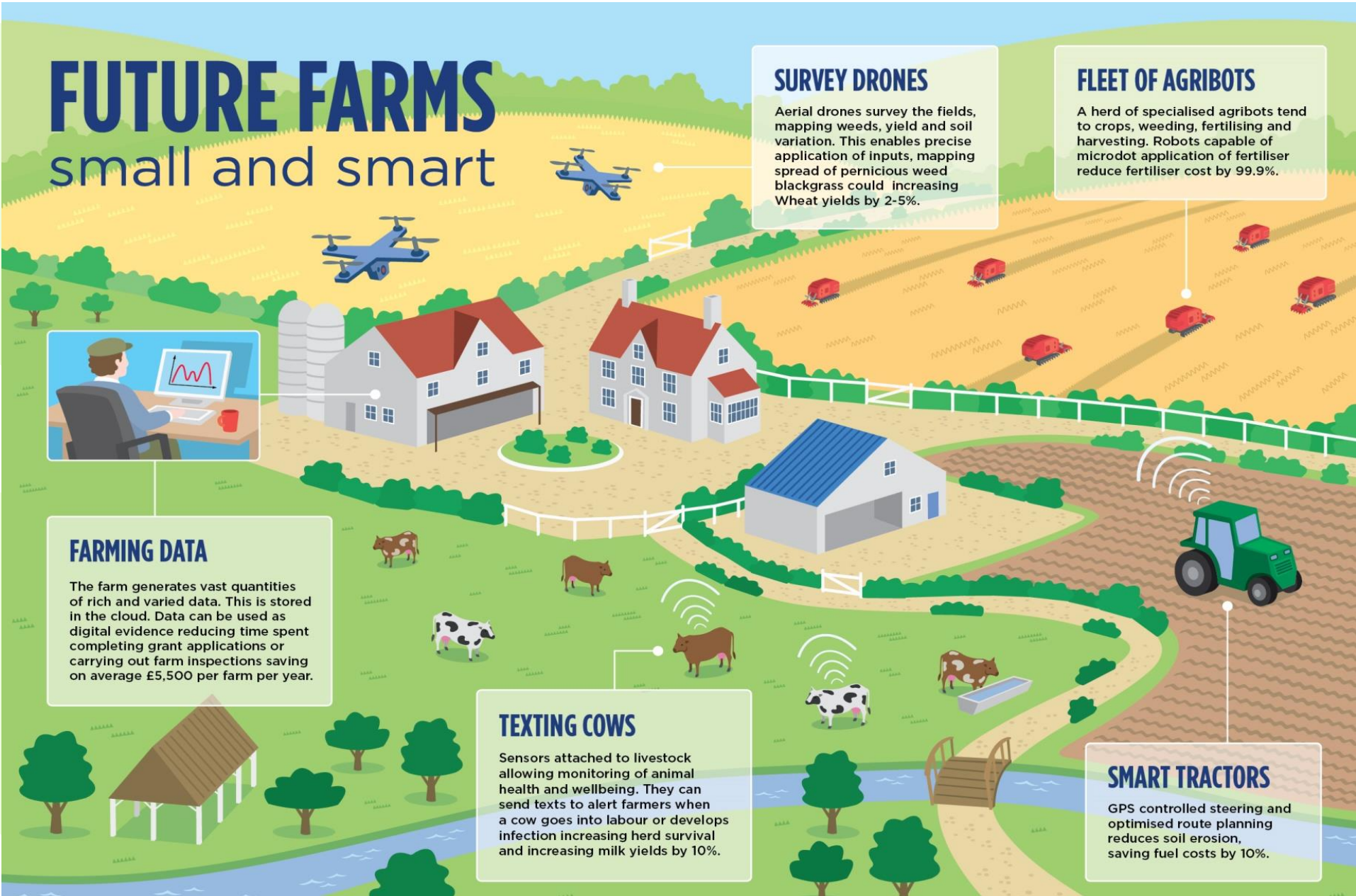
IoT: The Internet of Things

CENSIS

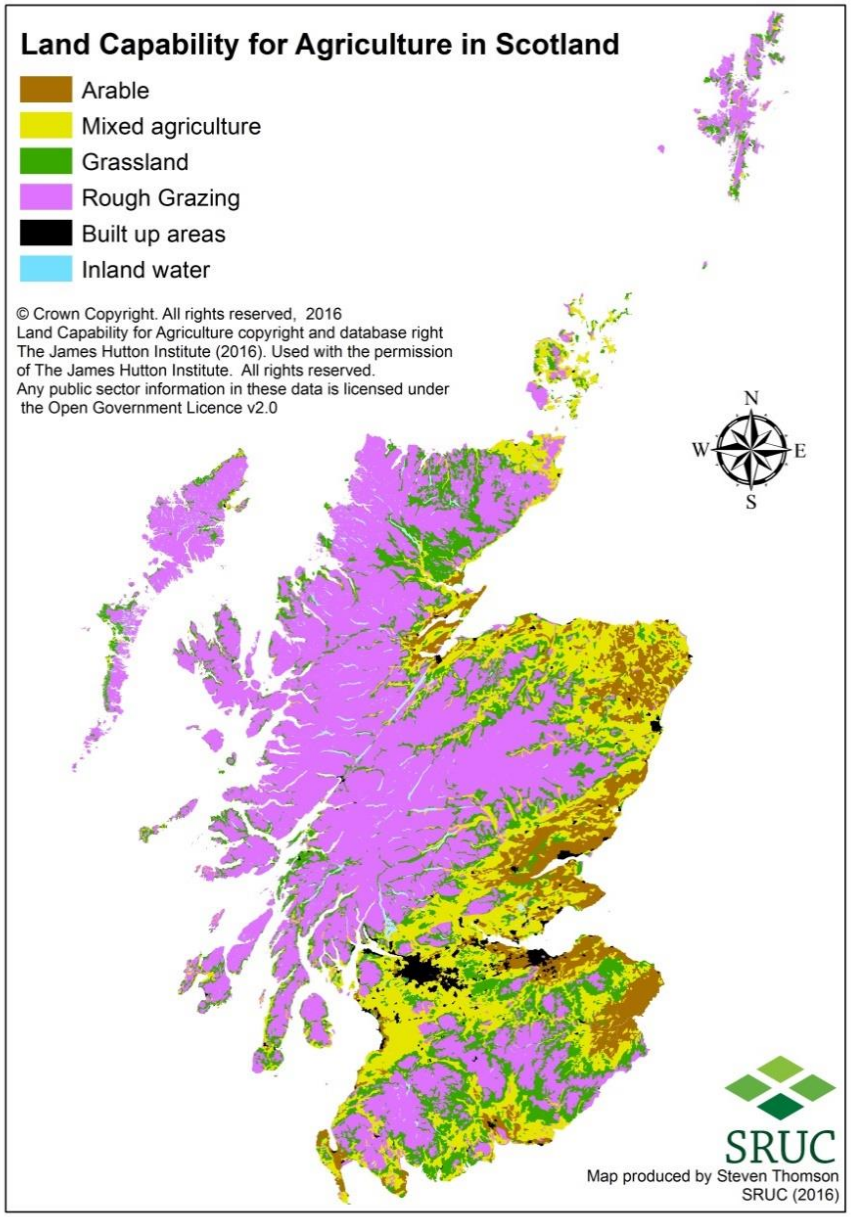
https://censis.org.uk/censis_projects/glasgow-pioneers-iot-connectivity-with-new-lora-network/

IoT: The Internet of Things

https://www.nesta.org.uk/blog/precision-agriculture-almost-20-increase-income-possible-smart-farming



Scottish uplands



Hill farming & crofting face a variety of challenges:

Agricultural challenges in upland Scotland

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Range of agricultural production challenges, e.g.:

- Low productivity
- Poor nutrition
- Pests and Disease
- Climate change
- Predation
- Blackloss

Low lambing percentages in spring
and/or
Low survival of lambs through to autumn






Range of public goods which hill farming & crofting has a role in providing:

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Protecting carbon stocks in soil & vegetation

Reducing flood risk

Increasing woodland cover

Supporting rural communities

Maintaining safe access routes for hill walkers

Maintaining the land for future generations

Maintaining good quality food production

Supporting wider Scottish economy

Maintaining local employment opportunities

Maintaining landscapes for tourism

Maintaining cultural heritage

Preventing and controlling wildfires

Improving water quality

Maintaining habitats and wildlife species

Ecosystem Approach

Data Collection a Challenge

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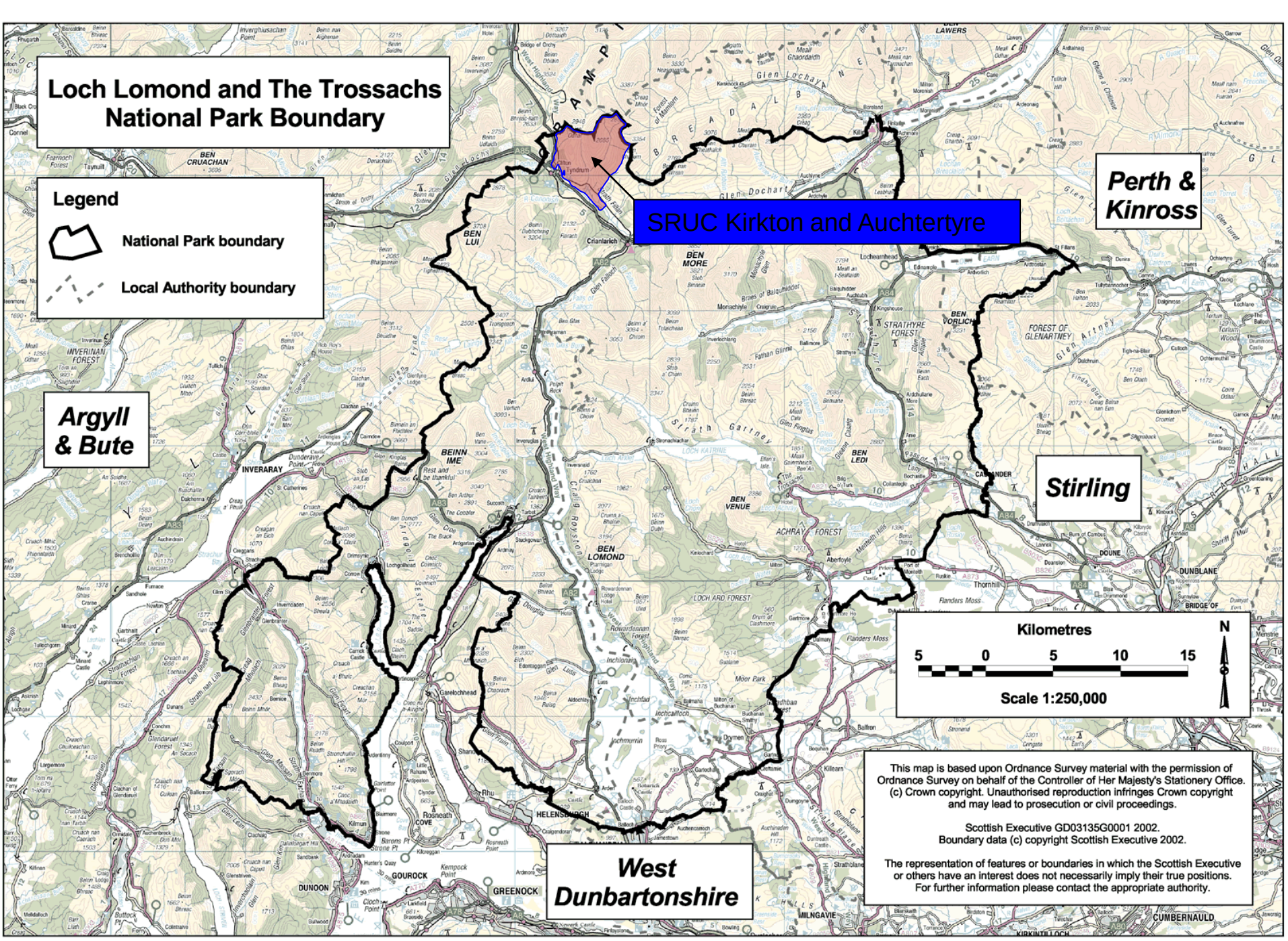
Loch Lomond and The Trossachs National Park Boundary
Legend
National Park boundary
Local Authority boundary
SRUC Kirkton and Auchtertyre
Perth & Kinross
Argyll & Bute
Stirling
West Dunbartonshire
Kilometres
5 0 5 10 15
Scale 1:250,000
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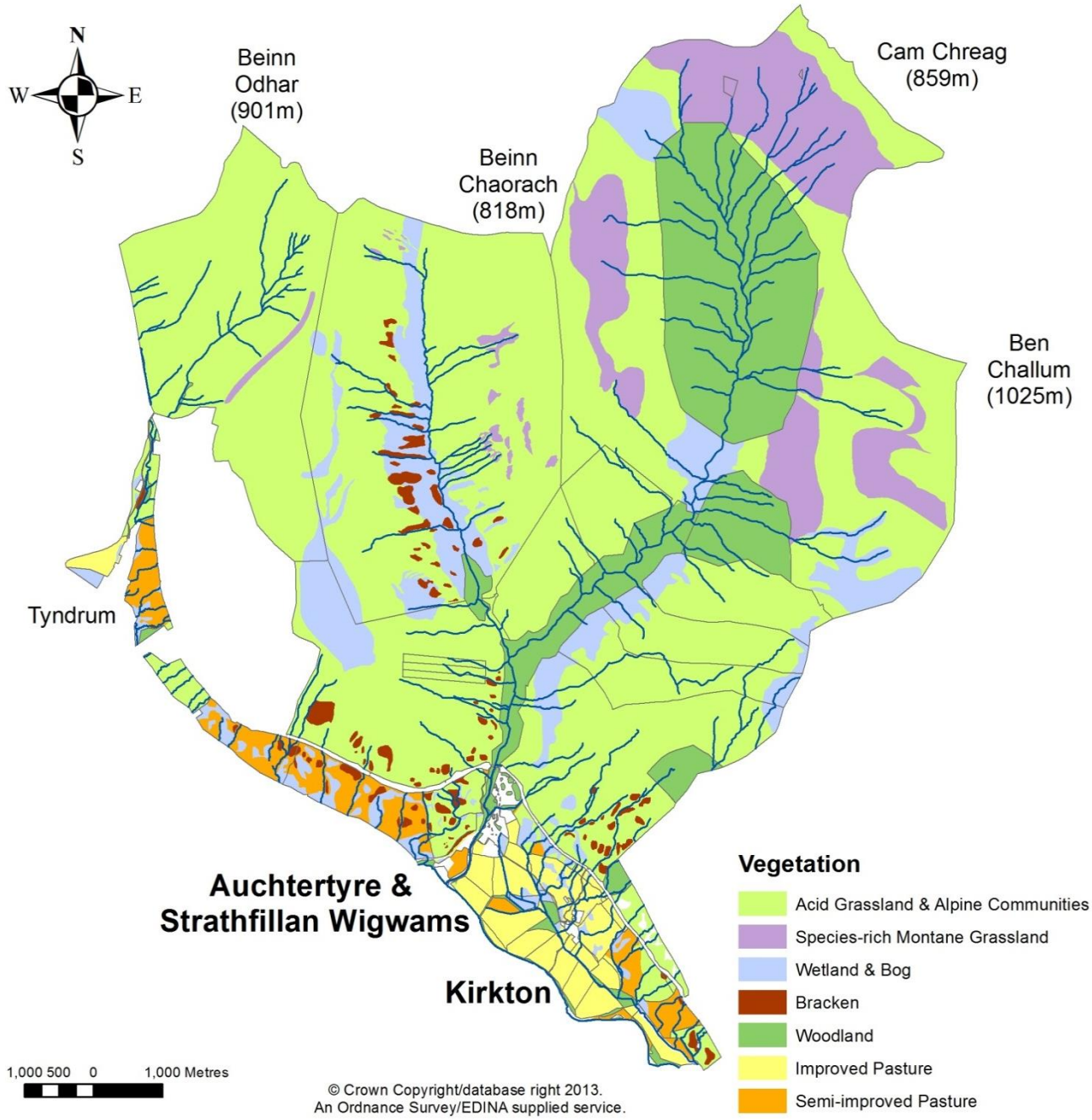

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Environment

Area: 2225 ha

Altitude: 180 - 1025 m

1 Munro (>3000 ft) – Ben Challum (1025 m)

3 Corbetts (>2500 ft) – Ben Odhar (901 m); Cam Chreag (884 m); Ben Chaorach (818 m)

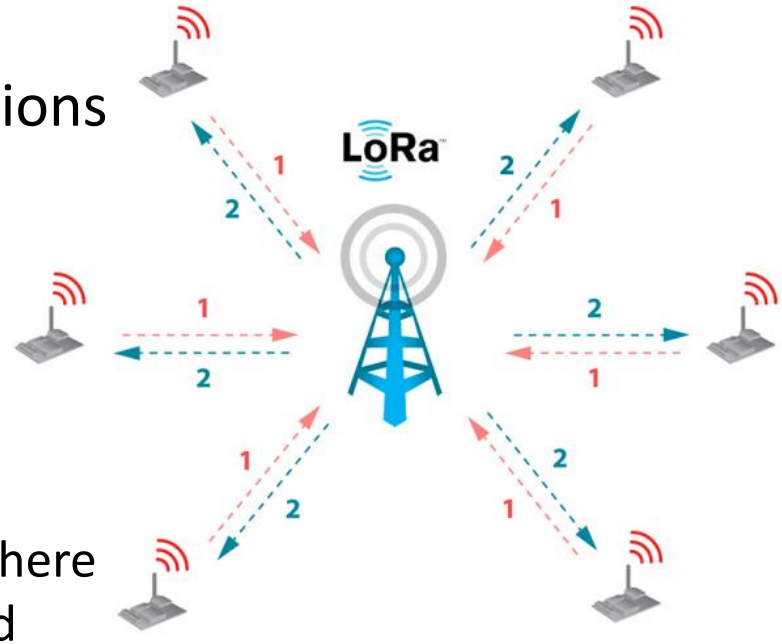
3 river catchments

Woodland expansion late 1990s

SRUC's Kirkton & Auchtertyre upland research farms

Internet of Things

- LoRaWAN
  - 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.








IoT: The Internet of Things

https://censis.org.uk/2017/09/22/censis-featured-in-2017-18-programme-for-government/

Scotland: a nation with ambition

Scotland: a nation with ambition, published earlier this month, lays out the Scottish Government's programme of action for 2017-18.

The government's economic ambition to build a modern, dynamic, open economy recognises the need to innovate, stay ahead of the competition and create jobs. We were pleased to see CENSIS mentioned on page 45, acknowledging us as an organisation that "supports Scottish businesses to develop their ideas and secure commercial opportunities by forging partnerships with universities and economic development agencies".

The Internet of Things and IoT networks are a key building blocks for industrial digitalisation and, also on page 45, the Programme notes the Scottish Government's commitment to "invest in a new and more supportive wireless sensor network. This national resource will transform the potential for businesses to explore sensor and imaging applications, to pilot their ideas and then launch proven, sustainable products and services into the global market."

The Scottish Government's Digital Strategy for Scotland, published in March 2017, notes its ambition to "develop a national LoRa-wide area network that supports Machine-to-Machine networking and puts Scotland at the cutting edge of the Internet of Things, while supporting our businesses to innovate and take full advantage of the economic opportunities offered by IOT." See page 22 of the document for more information.

Sheep tracking – data for one collared ewe in different fields over several days

Hoofprints SRUC

Map data ©2017 Google Imagery ©2017 DigitalGlobe, Getmapping plc


Tracks:
extract 8 acre 20 21 may 10 rolling average
River
Fillan
A82
Hoofprints
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LoRaWAN™ network: potential use cases

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Alerts to low levels in fuel/water storage tanks

Livestock tracking: alerts to off-farm movements

Tree growth & health

Array of soil temperature & moisture sensors: nutrient and grassland management

Water turbidity/dissolved oxygen: alerts to pollution incidents

LoRaWAN™ network: potential use cases

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LoRaWAN™ network: other queries?

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Rewarding the delivery of public goods?

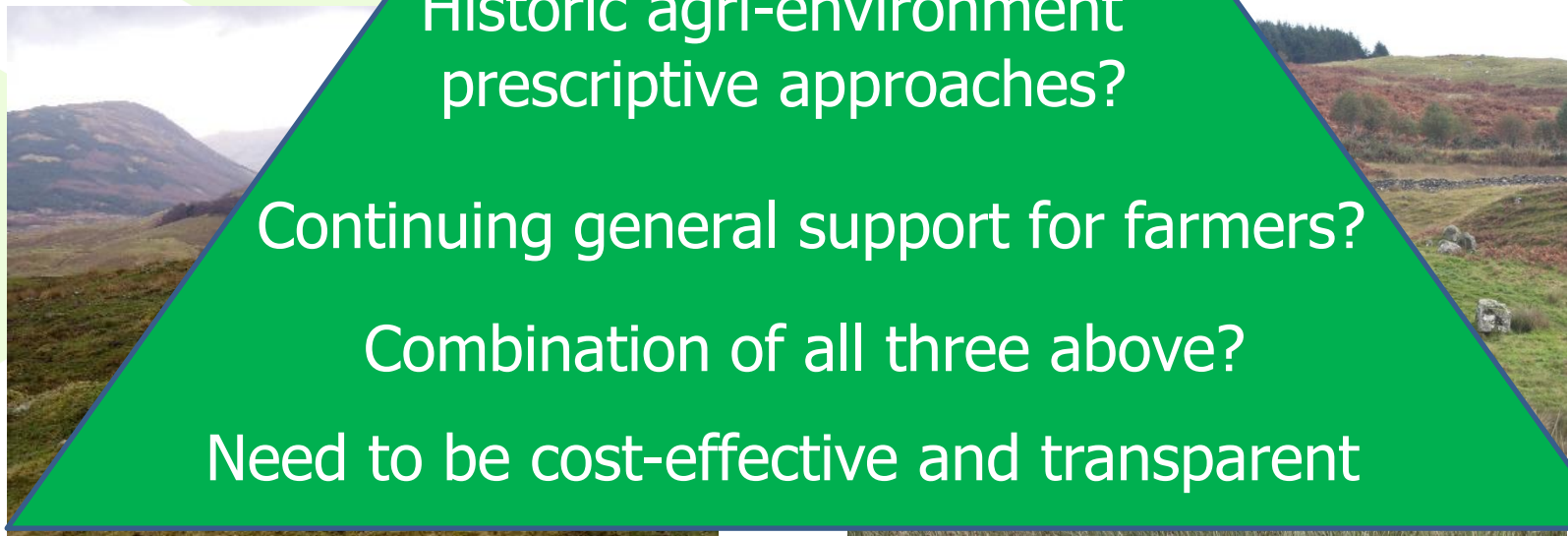
Outcome/Results based approaches?

Historic agri-environment prescriptive approaches?

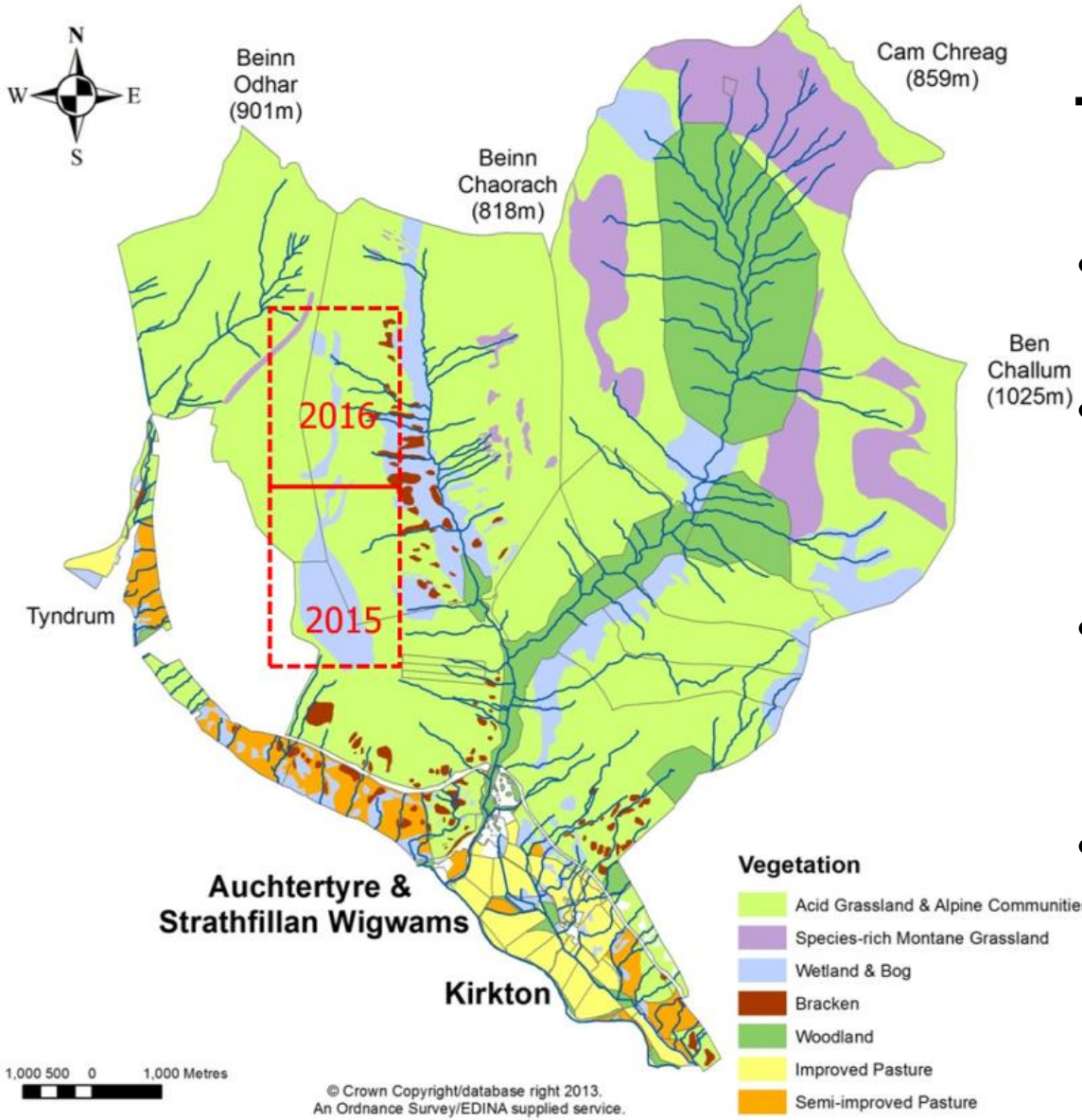
Continuing general support for farmers?

Combination of all three above?

Need to be cost-effective and transparent



High altitude peatland restoration



Total 2015 and 2016:

- c. 104 ha restored
- Over 15 km peat hag reprofiled
- Construction over 80 dams to rewet peat
- Revegetation of two large peat pans

Height of water in main river

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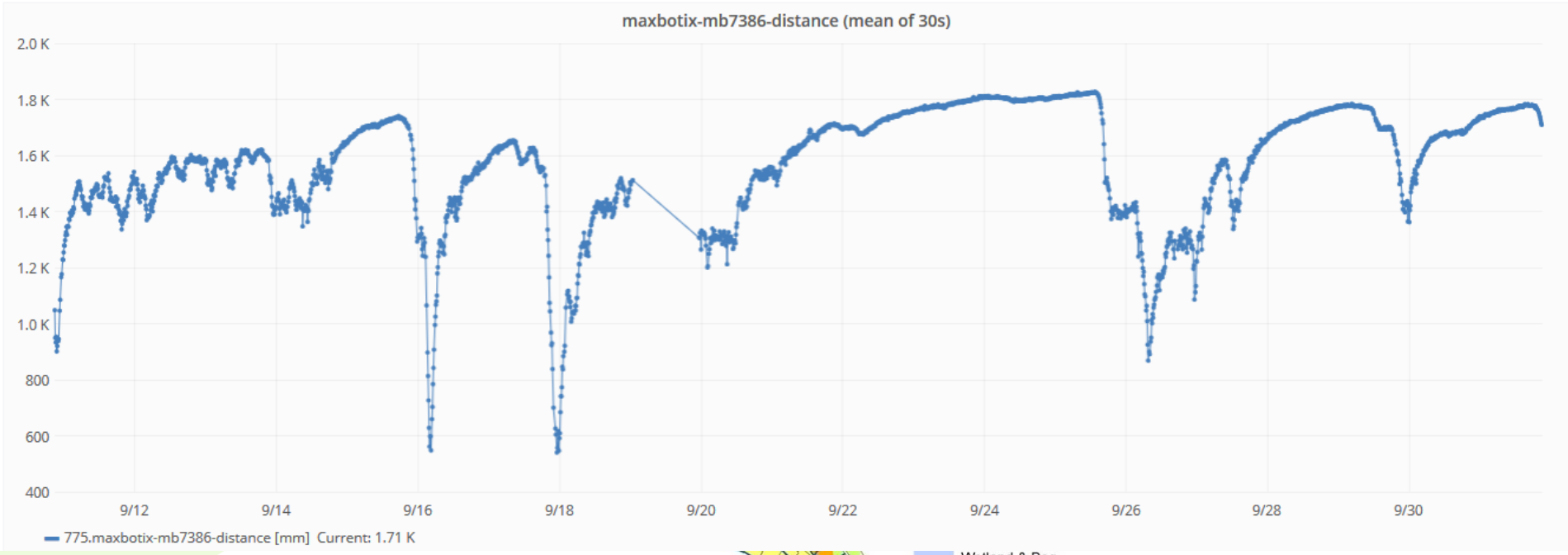
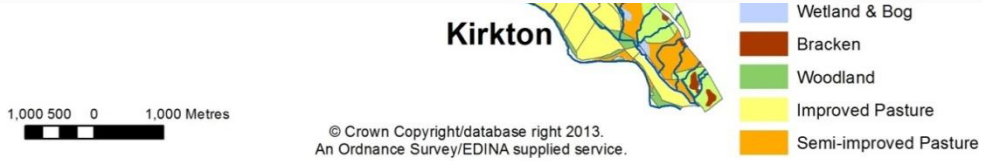
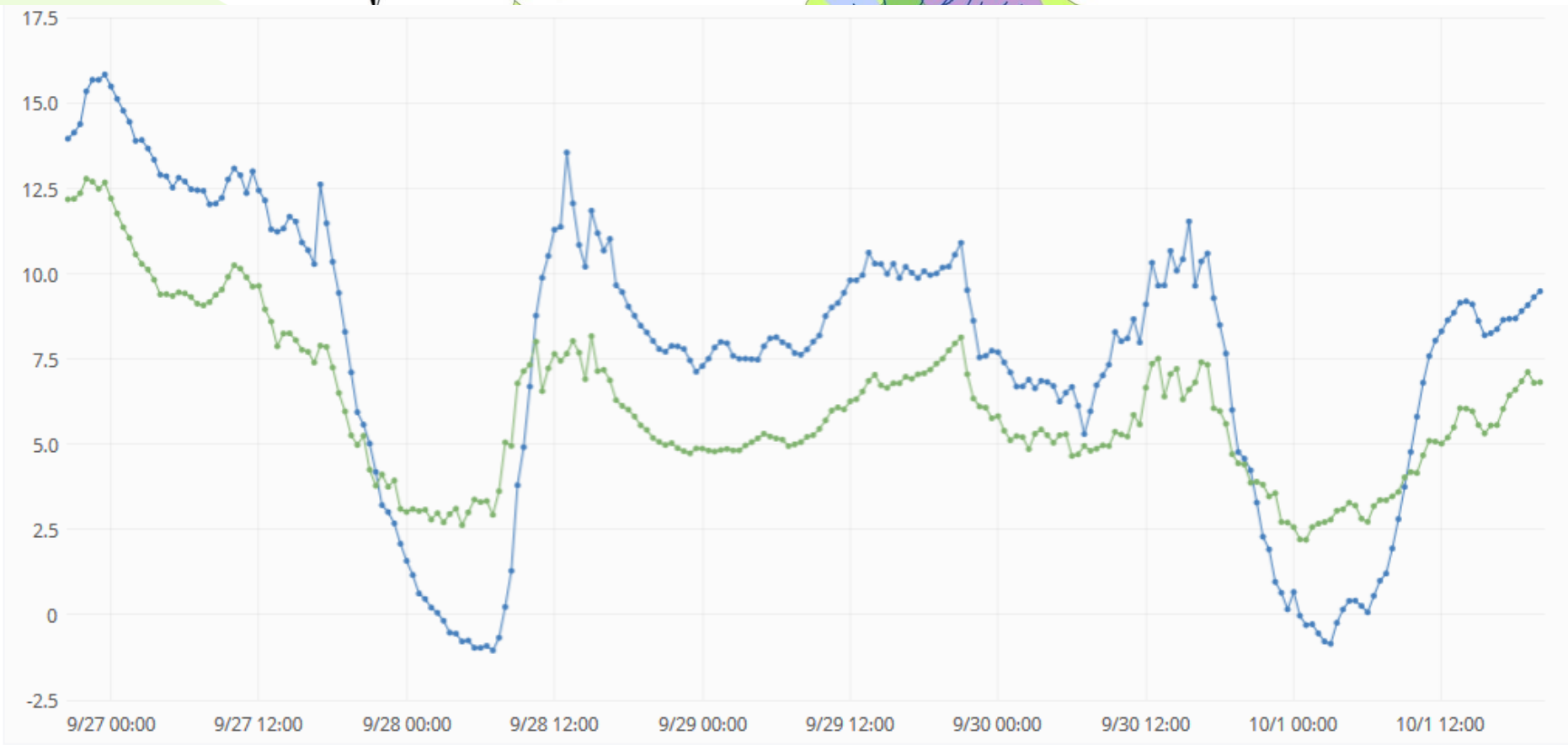
Infrastructure and services by decentlab





Air temperature: 170 m and 550 m



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Precision Agriculture and the Internet of Things (IoT)

CENSIS censis.org.uk

Engineering & Technology

Systems & ecology

Knowledge Transfer

Biological Sciences

DYW Developing the Young Workforce

For more detail see: http://www.sruc.ac.uk/news/120252/hill_and_mountain_research_centre

Acknowledgements

Much of the research conducted at SRUC's Hill & Mountain Research Centre has been funded by the **Rural & Environment Science & Analytical Services Division** of the **Scottish Government** through their **2011-2016** and **2016-2021 Strategic Research Programmes**

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- The **European Commission's H2020 Research & Innovation Programme**
- **Defra** under the **ERA-NET SusAn (Sustainable Animal Production) Programme**
- **Global Food Security's 'Resilience of the UK Food System Programme',** with support from **BBSRC, ESRC, NERC and Scottish Government**.