EuroFAANG

The European Functional Annotation of Animal Genomes

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The European Functional Annotation
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EuroFAANG - An infrastructure for farmed animal genotype to phenotype research in Europe and beyond

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EAAP, Annual Congress, 28th August – 1st September 2023

Overview

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- Farmed animal genotype to phenotype research
- What is FAANG?
- What is EuroFAANG?
- How does the EuroFAANG Research Infrastructure (RI) project want to integrate sustainably into the EU landscape of farmed animal research?

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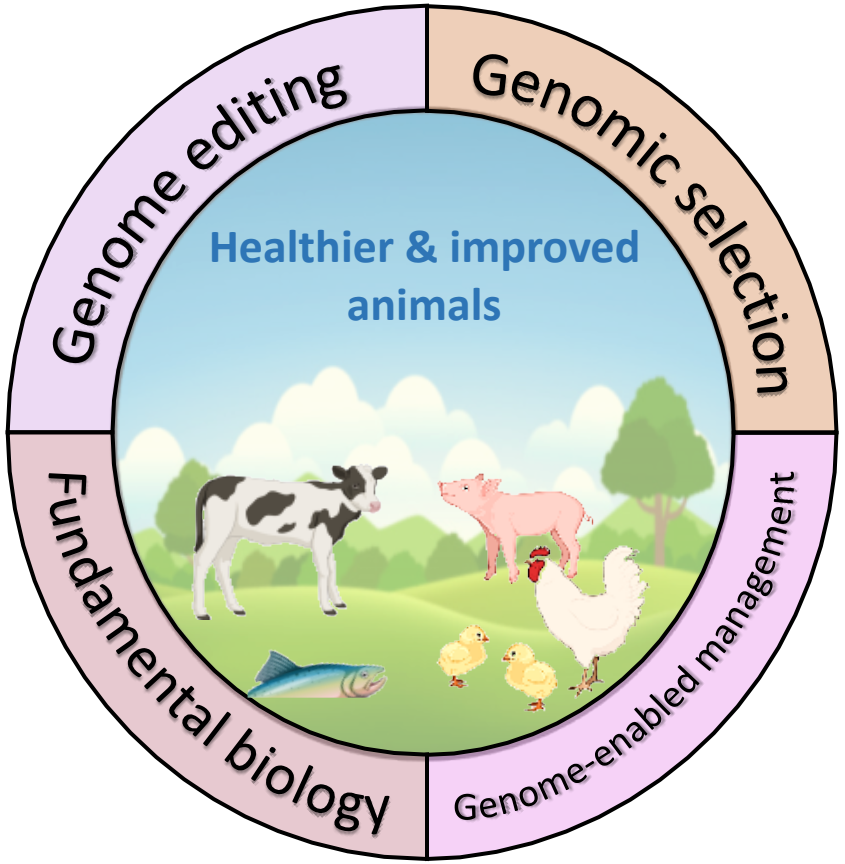
CODE • EFABAR
The commitment to responsible breeding

Farmed animal genotype to phenotype research

A breeding & management programme = balanced and responsible combination of several traits

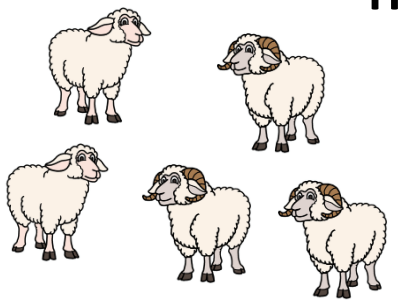


This is complex to achieve

Understanding more about the genetic code of farmed animals can benefit animal breeding and husbandry

EFFAB
European Forum of Farm Animal Breeders

Chief among the improvements required in animal breeding and management is the ability to more accurately use an animal's genetic code (genotype) to predict its characteristics (phenotype)



Thousands of genetic differences (“G”)
Hundreds of different characteristics (“P”)

Associate genetic code with characteristics (“G to P”)

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Generate prediction equation

Better Prediction Accuracy will lead to…

Breed the ‘best’ animals for:

- Disease resistance
- Reduced environmental impact
- Adaptation to changing environments

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Andersson *et al. Genome Biology* (2015) 16:57
DOI 10.1186/s13059-015-0622-4

Genome Biology

OPEN LETTER Open Access

Coordinated international action to accelerate genome-to-phenome with FAANG, the Functional Annotation of Animal Genomes project

The FAANG Consortium, Leif Andersson[1,2], Alan L Archibald[3], Cynthia D Bottema[4], Rudiger Brauning[5], Shane C Burgess[6], Dave W Burt[3], Eduardo Casas[7], Hans H Cheng[8], Laura Clarke[9], Christine Couldrey[10], Brian P Dalrymple[11], Christine G Elsik[12], Sylvain Foissac[13], Elisabetta Giuffra[14*], Martien A Groenen[15], Ben J Hayes[16,17,18], LuSheng S Huang[19], Hassan Khatib[20], James W Kijas[11], Heebal Kim[21], Joan K Lunney[22], Fiona M McCarthy[23], John C McEwan[24], Stephen Moore[25], Bindu Nanduri[26], Cedric Notredame[27], Yniv Palti[28], Graham S Plastow[29], James M Reecy[30], Gary A Rohrer[31], Elena Sarropoulou[32], Carl J Schmidt[33], Jeffrey Silverstein[34], Ross L Tellam[35], Michele Tixier-Boichard[14], Gwenola Tosser-Klopp[13], Christopher K Tuggle[30*], Johanna Vilkki[36], Stephen N White[37,38], Shuhong Zhao[39] and Huaijun Zhou[40]

- **Starting with White paper in 2015**

- **Global initiative:**
  - Non-institutional organisation
  - Community of labs/persons
  - Membership by subscription
  - Currently > 500 contributors

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FAANG website: the platform for global FAANG activities

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Functional Annotation of Animal Genomes

https://www.faang.org/

A coordinated international action to accelerate genome to phenome

Home | Structure | Activities | Data and Tools | To participate | more

Since 2015, the FAANG consortium is working to discover basic functional knowledge of genome function to decipher the genotype-to-phenotype (G2P) link in farmed animals. Our community is working to

- standardize core assays and experimental protocols,
- coordinate and facilitate data sharing through its Data Portal, and
- establish suitable infrastructures for data analysis.

We have described a set of research priorities for the next decade of FAANG research (FAANG to Fork strategy) to link G2P in diverse populations of animals and apply innovative new technologies to model G2P at the cell, tissue and whole animal scale.

Join Task Forces!

- FAANGPrediction
- metaFAIR
- FarmGTEx
- FAANGSingleCell
- FAANGCompGen
- HTP-DS

Projects

Data Portal

Get involved

» Join us

For FAANG membership:

The FAANG Data Sharing Statement Version 2.0 (December 1, 2021)

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- **Goals:**

  - standardize core assays and experimental protocols
  - coordinate and facilitate data sharing via the FAANG Data Portal
  - establish suitable infrastructures for data analysis.

→ **for improved farmed animal genotype-to-phenotype prediction**

- **Major recent initiatives within FAANG**
  - US FAANG
  - DairyBio (Australia)
  - Genome Canada
  - AG2PI (USA)
  - Horizon 2020 (Euro)FAANG
  - Horizon Europe (Euro)FAANG

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A little bit of history about “EuroFAANG” initiatives

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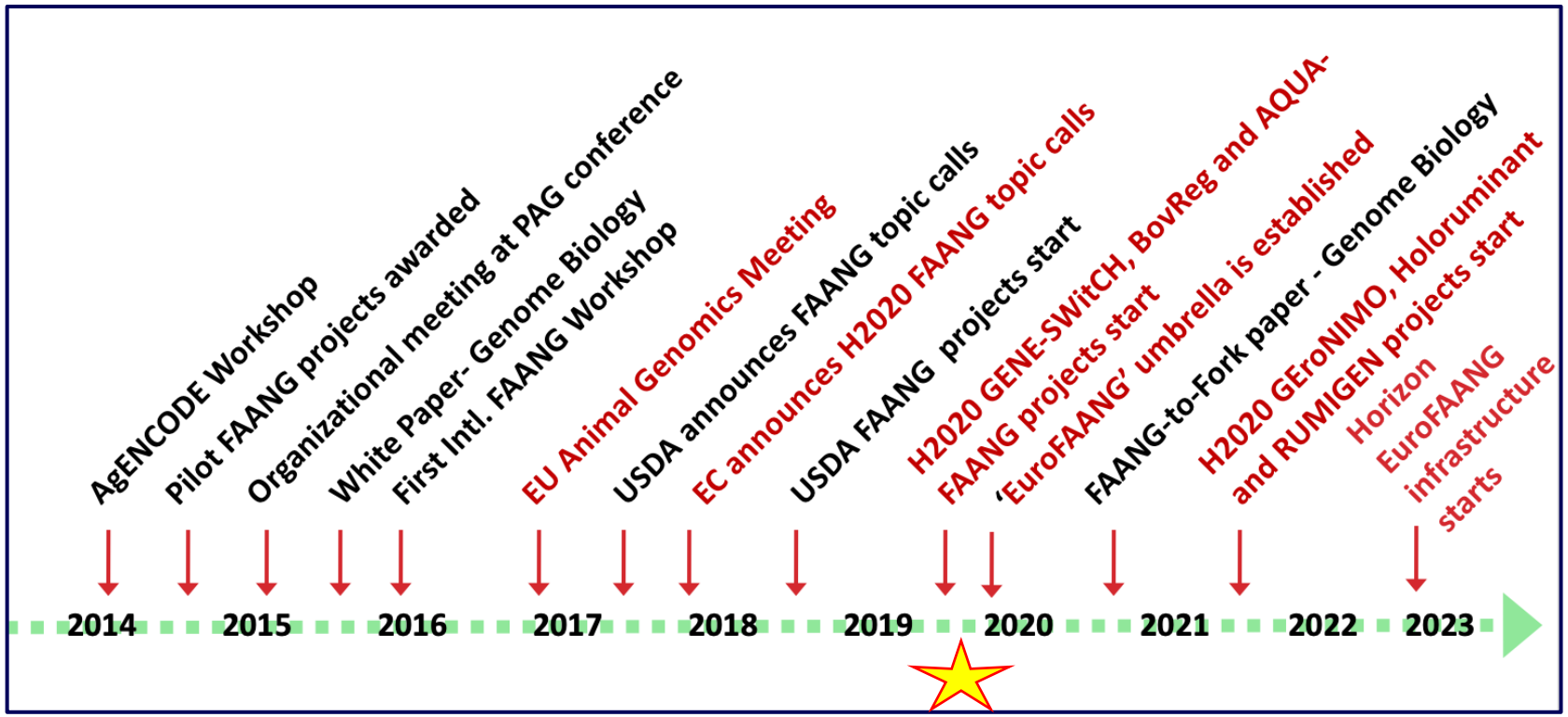

- COST action FAANG-Europe

- EuroFAANG cluster from H2020 funded projects

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The EuroFAANG H2020 cluster of individually funded projects

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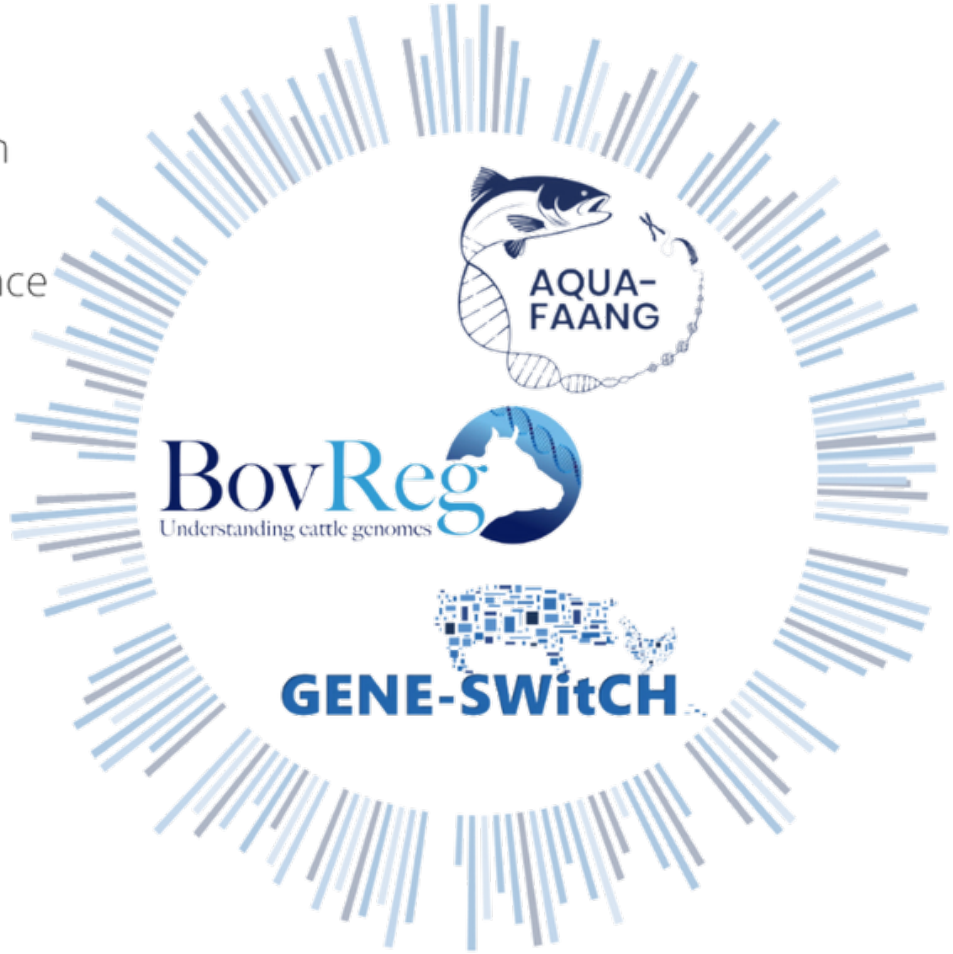
Research aims

- ☑ Increase effiency through precision breeding
- ☑ Increase disease resistance
- ☑ Minimise environmental impact

Joint strategies

- ☑ Communication & Dissemination
- ☑ Training
- ☑ Research Methodology



HoloRuminant
Understanding microbiomes of the ruminant holobiont

GERONIMO
Rumigen
TOWARDS IMPROVEMENT OF RUMINANT BREEDING THROUGH GENOMIC AND EPIGENOMIC APPROACHES

More recently joined H2020 Projects

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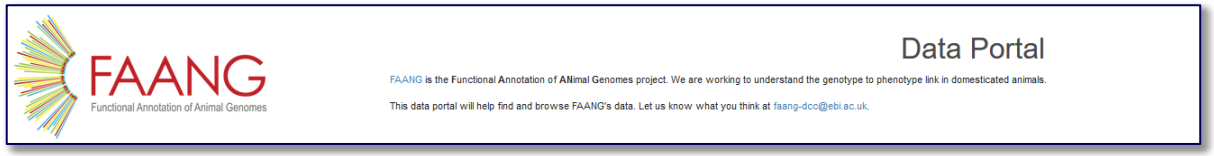
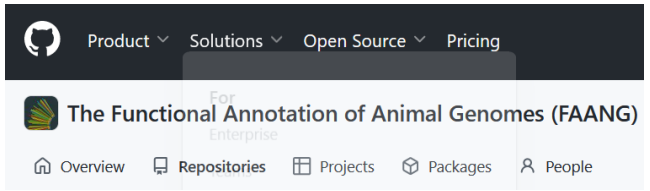
The FAANG data coordination center

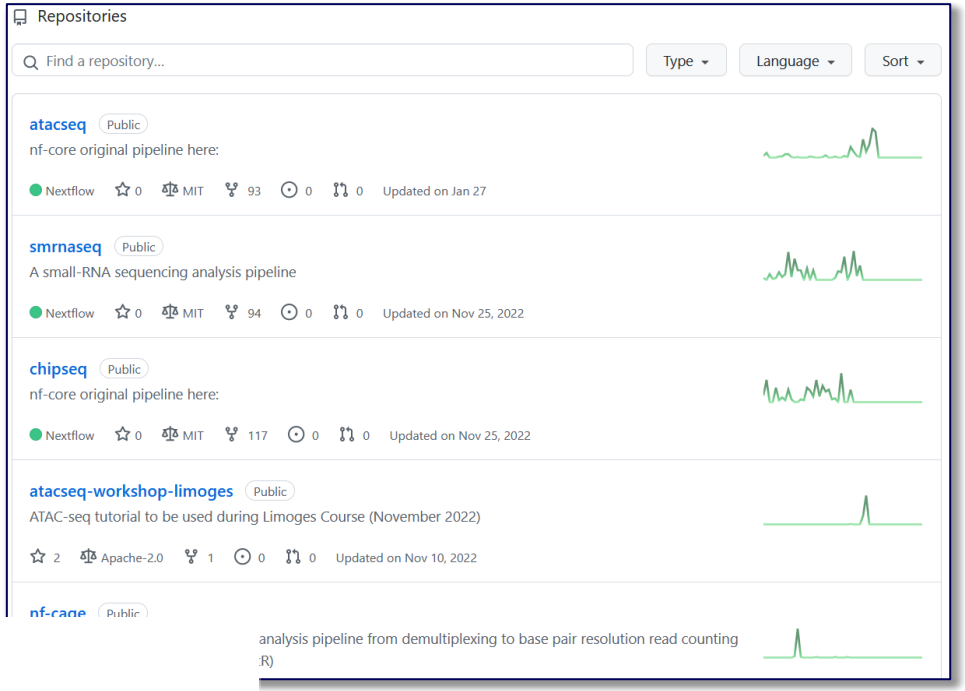
https://data.faang.org/home, at the moment financially supported by the H2020 cluster projects and the EuroFAANG project



- **Downloads**
  - Data sets
  - Files
  - Analyses
  - Protocols
  - Publications
- **Visualization**
  - Track hubs (beta version)
- **Project environments**
  - BovReg
  - Gene-SWitCH
  - Aqua-FAANG
  - Geronimo
  - Rumigen
  - HoloRuminant
- **Ontology improver**



- *https://github.com/orgs/FAANG/repositories*
- *https://github.com/BovReg*



The FAANG Data Portal benefits the entire farmed animal research community

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A little bit of history about “EuroFAANG” initiatives

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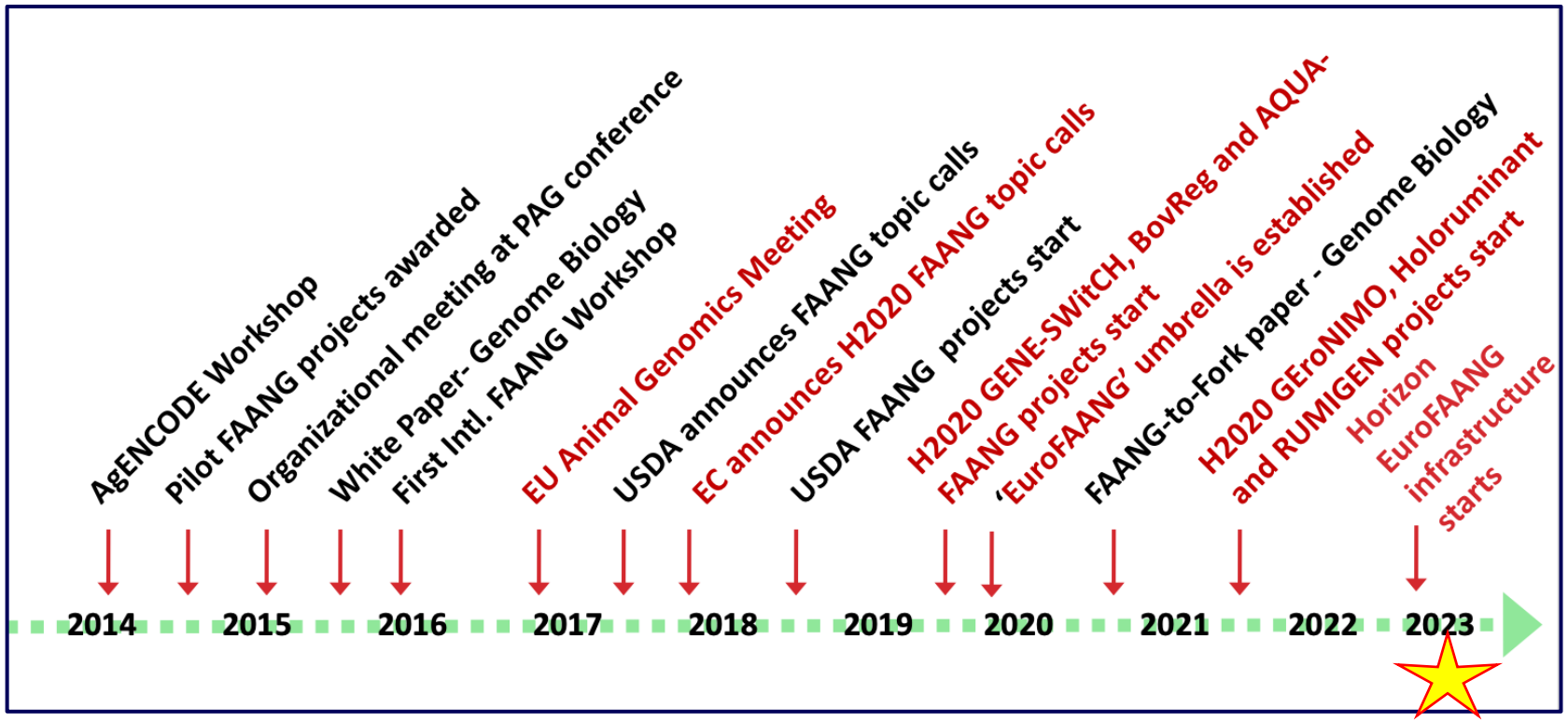

- COST action FAANG-Europe

- EuroFAANG cluster from H2020 funded projects

- the new EuroFAANG RI project

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The EuroFAANG Research Infrastructure Project

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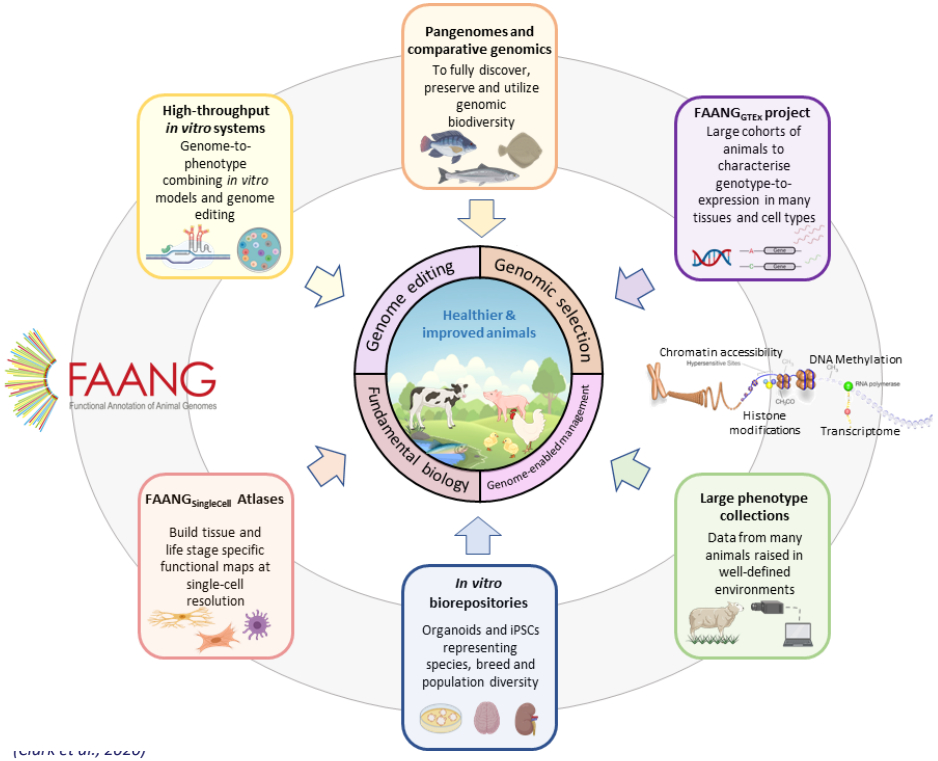
- New Horizon Europe infrastructure project
- Run time: 2023 - 2025 Coordinator: FBN



Research aims

- Increase effiency through precision breeding
- Increase disease resistance
- Minimise environmental impact

Joint strategies

- Communication & Dissemination
- Training
- Research Methodology

Partners:

- University of Edinburgh
- INRAE
- Wageningen University
- FBN
- Norwegian University of Life Sciences
- EMBL-EBI
- European Forum for Farm Animal Breeders

- **Aim: Establish an infrastructure to facilitate research and innovation for genotype to phenotype (G2P) prediction in farmed animals (terrestrial and aquatic) to achieve sustainable, efficient and socially accepted farmed animal production in Europe**

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The EuroFAANG Infrastructure has four main objectives:

1. Creation of a common data structure and data access.
2. Development, of a European framework for curation and biobanking of *in vitro* cellular models.
3. Sharing and expanding capabilities in new breeding, phenotyping, and genomic technologies.
4. Connecting with existing projects and infrastructures to consolidate G2P research in farmed animals across Europe and globally.

SmartCow

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PIGWEB

AQUA EXCEL 3.0

elixir

AgBioData
Toward enhanced genomics, genetics, and breeding research outcomes through standardization of practices and protocols across agricultural databases

EuroFAANG

Phenotyping

Data

The EuroFAANG RI project:

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- Does not provide infrastructure access or services, but is a concept development project.
- Aims to bring together infrastructures and resources in farmed animal research to provide an attractive package to be eligible as a ESRI project for consideration on the roadmap with a sustainable perspective.
- Will start a large number of activities (surveys, workshops, stakeholder meetings, lobbying, global networking, outreach to existing RIs (including EU framework and ESFRI RIs), ….
- Needs comprehensive collaboration within the entire farmed animal research community and animal breeding sector to moving forward from concept development to project preparation.
- Will provide multiple opportunities to associate with activities and be part of a future EuroFAANG ESFRI proposal.

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European Strategy Forum on Research Infrastructures (ESFRI)

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ESFRI

- **Members**
  - 27 EU member states
  - associated countries *(Albania, Armenia, Bosnia and Herzegovina, Faroe Islands, Georgia, Iceland, Israel, Lichtenstein, Montenegro, Northern Macedonia, Norway, Switzerland, Serbia and Ukraine)*
- **Aim**
  - coordinating the various European research infrastructure initiatives
  - jointly establishing and operating new research data infrastructures
  - developing a research data **infrastructure roadmap** that is updated at regular intervals
- **ESFRI Roadmaps**
  - coordinating the various European research infrastructure initiatives
  - organized in five scientific domains: Digital / Energy / Environment/ Physical sciences & Engineering /Social & Cultural Innovations/**Health & Food**

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The ESFRI environment ‘Health and Food’

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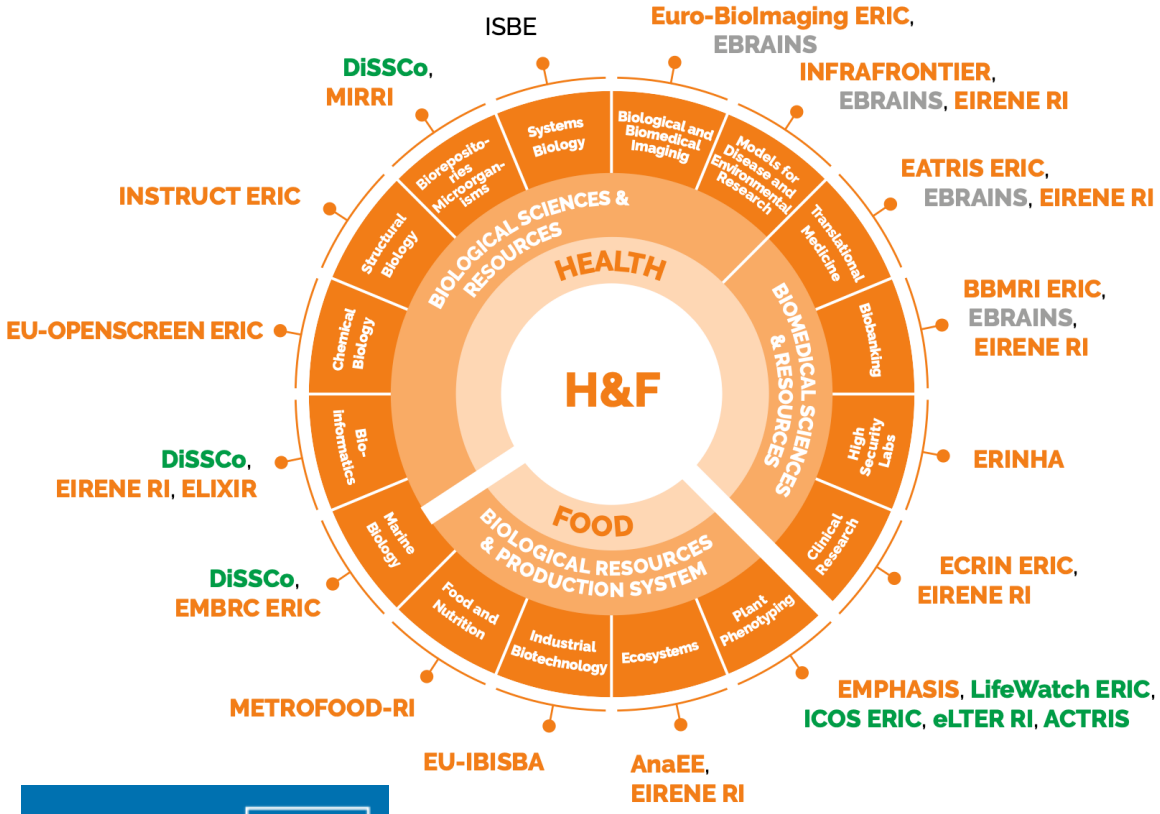

European Strategy Forum on Research Infrastructures ESFRI

Strategy Report on Research Infrastructures RoadMap 2021 – Landscape of ‘Health and Food’

- The remit of the ESFRI ‘Health and Food’ research infrastructures:

  “generate readiness to meet the current challenges and demands in the Agri-Food sector in Europe.”

- Outcome of the 2021 Roadmap landscape review:

  “Concerted effort to continue bringing together national facilities at the pan-European level in the field of animal genetic resources, phenotyping and breeding, animal health is needed to contribute to address the challenge to produce safe, healthy and sustainable food.”

The need to bring together national facilities at the pan-European level in the field of animal genetic resources, phenotyping, breeding, and animal health was identified as a gap.

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Lifecycle approach of a research infrastructure

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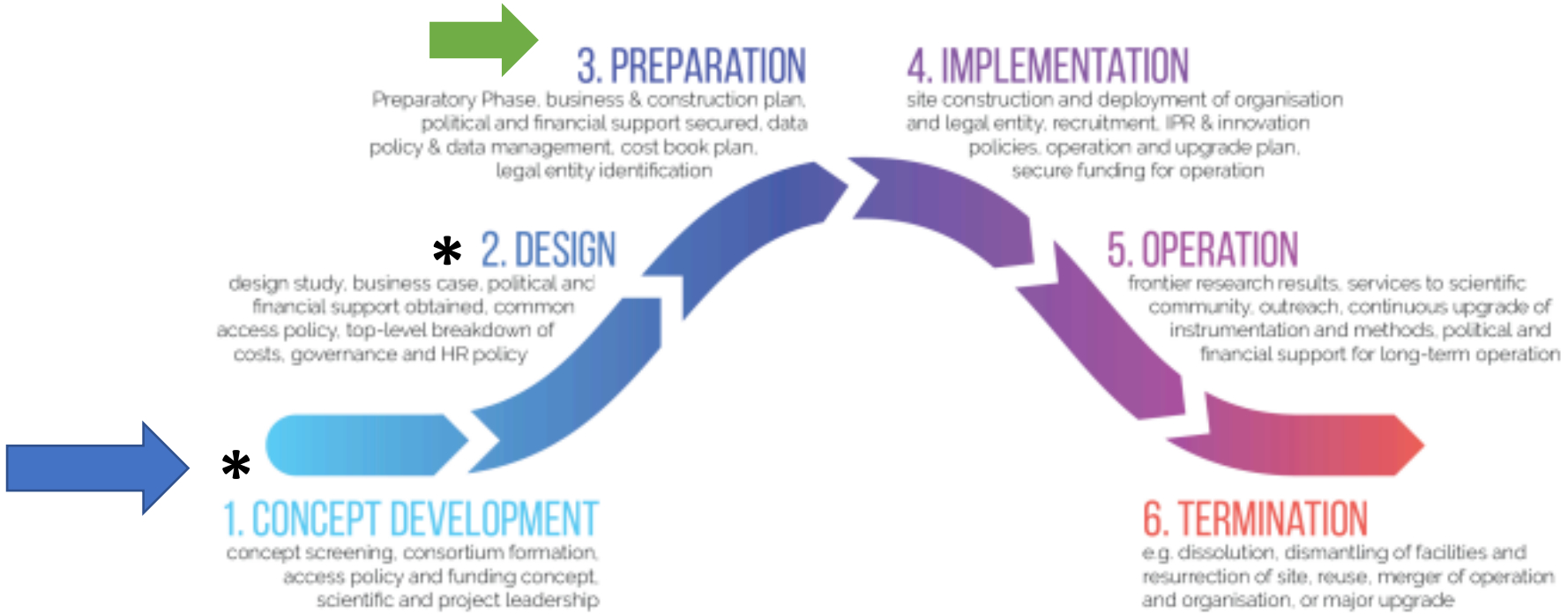

HORIZON-INFRA-2022-DEV-01 Research Infrastructure Concept Development

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The EuroFAANG RI project
WP overview and interdependencies

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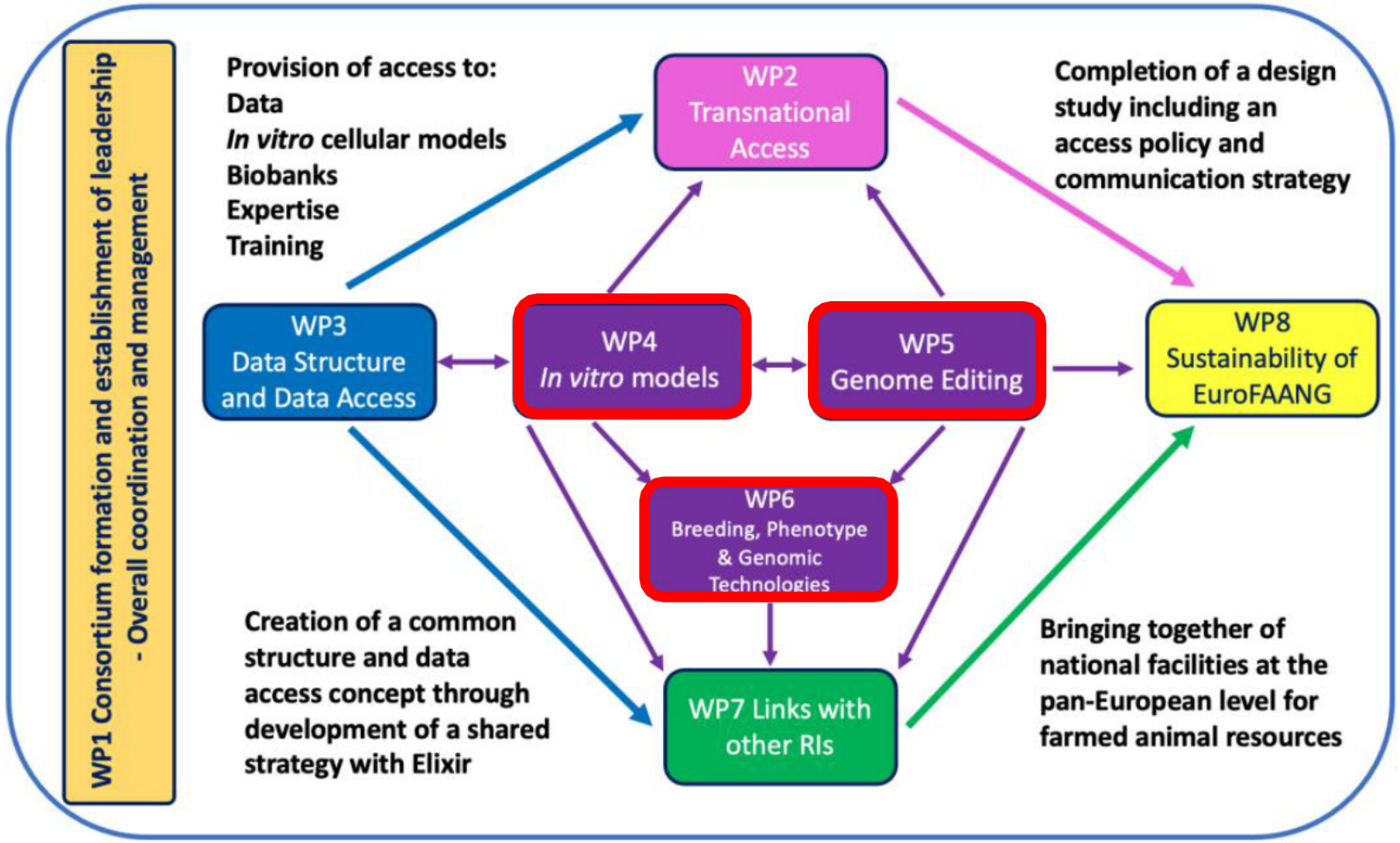

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Summary

- The EuroFAANG infrastructure will contribute to addressing the need to bring together national facilities at the pan-European level for animal genetic resources, phenotyping and breeding, and animal health.

✓ Filling the gap identified in the infrastructure landscape by the 2021 ESFRI Roadmap.

- The EuroFAANG infrastructure builds on the six H2020 projects and connects with existing infrastructures for data management and animal agriculture in the European research infrastructure landscape.

✓ Leading to a better alignment of the research infrastructure landscape for farmed animal science and frontier G2P research in Europe and globally.

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10 Years

EuroFAANG partners

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WAGENINGEN
UNIVERSITY & RESEARCH

NMBU
Norwegian University
of Life Sciences

EFFAB
European Forum of
Farm Animal Breeders

FBN

EMBL-EBI

INRAE

ROSLIN

THE UNIVERSITY OF EDINBURGH

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RESEARCH INFRASTRUCTURE

AQUA-FAANG
BovReg
Understanding cattle genomes
GENE-SWitCH
GERONIMO
GENOME AND EPIGENOME ENABLED BREEDING IN MONOGASTRICS
Rumigen
TOWARDS IMPROVEMENT OF RUMINANT BREEDING THROUGH GENOMIC AND EPIGENOMIC APPROACHES
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Thank you for your attention!

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EuroFAANG panel discussion session

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- ✓ Basic research as lever for practical application in breeding programs and management
- ✓ Still bottlenecks hinder seamless research integration into practical application
- ✓ Expectations are up by stakeholders for future research directions to overcome those gaps and bottlenecks
- ✓ The multitude of societal, ecological and economical challenges for animal farming and animal breeding in particular will require a focussed vision of resilient and innovative future practices and respective research demands.

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