Fitter LiveStock Farming

What R&I can deliver to support climate mitigation and adaptation in livestock farming

Afternoon Workshop in Brussels, 6 Nov. 2019

Fitter LiveStock Farming - These projects have received funding from the European Union's Horizon 2020 (H2020) Research and Innovation programme under Grant Agreements: GENTORE - 727213; Feed-a-Gene- 633531; SAPHIR - 633184; IMAGE - 677353; GplusE - 613689; SmartClow – 730924.

Programme

- 14.00: Welcome
  - By Jean-Louis Peyraud, ATF President, and Nic Friggens, Fitter LiveStock Farming
- 14.05: Short introduction
  - By Jean-Charles Cavitte, European Commission - DG AGRI
- 14.10: Insights into projects outcomes: what is in for stakeholders on the common theme?

  Chair: Nic Friggens, coordinator GenTORE and CDB cluster
  - Introduction by Nic Friggens
  - Pitches by 6 projects coordinators from the Fitter Livestock Farming CDB cluster: GplusE (representative: Andrew Cromie), SAPHIR (Marie-Hélène Pinard-van der Laan), IMAGE (Michèle Tixier-Boichard), Feed-A-Gene (Jaap van Milgen), GenTORE (Nic Friggens), SmartCow (René Baumont)
  - Questions to coordinators & answers
- 15.10: What R&I is needed to support climate mitigation and adaptation in livestock farming?
  - Discussion with project coordinators and the audience

  Moderation: Vivi H. Nielsen, ATF Vice-President for research providers/Aarhus University

  With the contributions of other H2020 programmes
- 16.00: Recap and ATF vision
  - By Jean-Louis Peyraud, ATF President
- 16.15: Closing

Fitter Livestock Farming: project outcomes for stakeholder engagement

- Livestock farming IS serious about mitigating climate change and adapting to environmental challenges
- "Fitter Livestock Farming" Cluster of 6 recent and on-going projects
  - Common Dissemination Booster initiative of the Commission
- Brief overview of insights from these projects
- We challenge you, the stakeholders, to get involved

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GplusE

Presented by Mike Lynch – ICBF

www.gpluse.eu

https://twitter.com/*GplusE_eu*

15/11/2019

GplusE - Introduction

- Five year EU funded project – 2014 to 2018
- 15 partners
- 9 individual work packages

Develop and exploit genomic data and analytical tools, new phenotyping approaches and breeding strategies for sustainable dairy production system

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GplusE - Partners

UCD: University College Dublin
School of Veterinary Medicine
Dublin, Ireland

RVC: Royal Veterinary College
London, UK

AFBI: The Agri-Food and Biosciences Institute
Belfast, Northern Ireland, UK

UGent: Universiteit Gent
Department of Reproduction, Obstetrics and Herd Health, Faculty of Veterinary Medicine
Merebelke, Belgium

AU: Aarhus University
Department of Animal Science
Foulum, Denmark

CREA: Consiglio per la Ricerca in Agricoltura e l'Analisi dell'Economia Agraria
Roma, Italy

ICBF: The Irish Cattle Breeding Federation Society Limited
Bandon, Ireland

HZAU: Huazhong Agricultural University
Wuhan, China

s-EAAP: Service EAAP Srl
Rome, Italy

Unifarm: Unifarm BVBA
Assen, Netherlands

KCA: The Knowledge Centre for Agriculture
Aarhus, Denmark

MU: University of Missouri
Animal Sciences Division
Columbia, MO USA

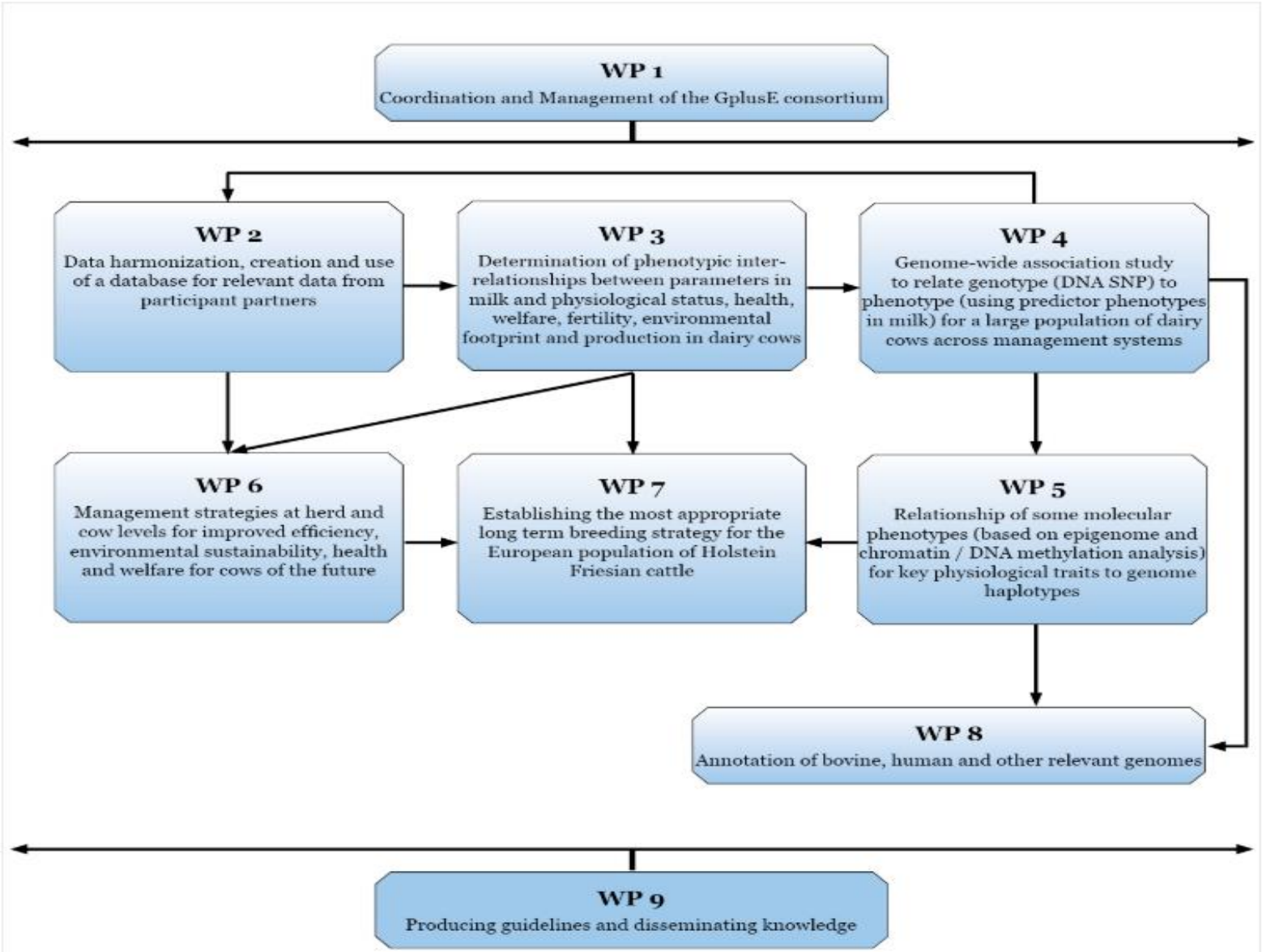
ULg-Gx : University of Liège, Gembloux Agro-Bio Tech
Gembloux, Belgium

ULG-FVM:
University of Liège, Faculty of Veterinary Medicine
Unit of Animal Genomics, GIGA-Research
Liège, Belgium

CRA-W: Walloon Agricultural Research Centre
Department for Quality of Agricultural Products
Gembloux, Belgium

FBN: Leibniz Institute for Farm Animal Biology
Dummerstorf, Germany

GplusE – Work Pacakges



GPlusE – Some relevant outcomes

Results show that one can detect cows with imbalanced energy status thanks to the measurement of a few biomarkers in milk.

These will enable animal breeders to improve the selection of resilient, efficient , productive animals.

They will also help farmers, veterinarians and MROs to manage dairy herds better, via individual monitoring of the health and welfare of the animals.

GPlusE – Outcomes for Phenotypes

- Milk MIR spectra can be used for cheap, easy to implement and accurate prediction of the metabolic status of dairy cows
- Milk MIR spectra might also be used for predicting many other innovative phenotypes (e.g., GplusE added knowledge on the prediction of Nitrogen efficiency of dairy cows)
- The combined measurements of BHB (Beta-Hydroxy-Butyrate), NEFA (Non esterified Fatty Acids) and IGF-I (Insulin-like growth factor 1) allows determination of whether the energy metabolism of an animal is imbalanced.

GPlusE – Outcomes for Breeding

Targeted combination of estimated breeding values for lower accuracy MIR based biomarkers increased their usefulness in genetic evaluation of dairy cattle for robustness.

Genome wide association studies may help in selection for improved resilience of dairy cattle to heat stress

GPlusE – GHG Summary

- Access to high value phenotypic data will be key to ..
  - Getting an accurate measure of GHG emissions from livestock
  - Implementing breeding and management policies that reduce the GHG impacts of livestock farming in a measurable way
- New technologies provide innovative ways of collecting phenotypes however..
  - Accuracy, standardization and field testing are vital
  - Existing technologies are still as important e.g accurate liveweight data as an indication of feed efficiency
- Genomics & Genetics are key tools in GHG mitigation and ..
  - Newer studies show direct correlation between improved genetic merit and reduced GHG emissions

Fitter LiveStock Farming

SAPHIR

Strengthening Animal Production and Health through the Immune Response

Presented by Marie-Hélène Pinard-van der Laan, project co-coordinator *

www.h2020-saphir.eu

https://twitter.com/*SAPHIR_H2020*

Isabelle Schwartz-Cornil, coordinator *

SAPHIR Strengthening Animal Production and Health through the Immune Response

atf animal task force A European Public-Private Platform

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SAPHIR

European Commission

HORIZON 2020
THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION
2015-2019

Issue of climate mitigation and adaptation ??

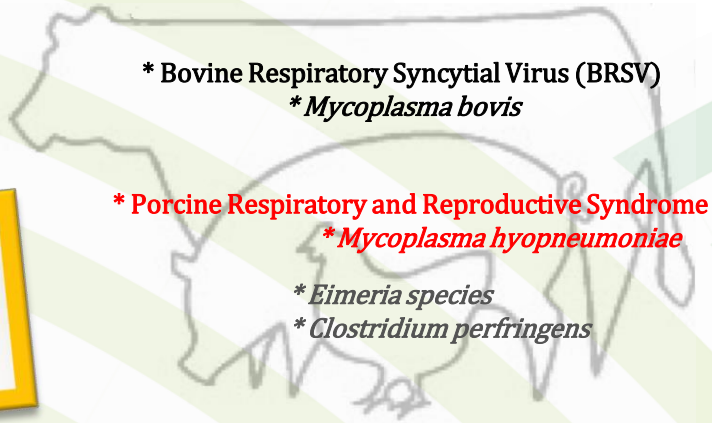
ULTIMATE G

SCOPE

Novel Tools for Healthier Livestock

- **Generate effective, safe, affordable <u>vaccination strategies</u> towards the control of endemic pathogens responsible for economic losses in livestock**
- **Integrated approaches against <u>representative pathogens</u>**

INTEGRATED SRATEGIES



* Bovine Respiratory Syncytial Virus (BRSV)
** Mycoplasma bovis*

* Porcine Respiratory and Reproductive Syndrome Virus (PRRSV)
** Mycoplasma hyopneumoniae*

** Eimeria species*
** Clostridium perfringens*

SAPHIR
Strengthening Animal Production and Health through the Immune Response

Brussels, 6 November 2019

atf animal task force
A European Public-Private Platform

IMPACTS OF CLIMATE CHANGE ON ANIMAL HEALTH & WELFARE

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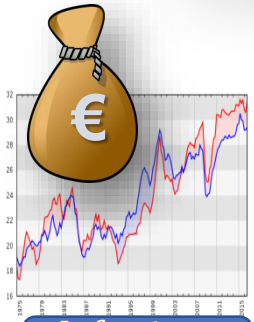
Direct effects Heat Stress

Indirect effects

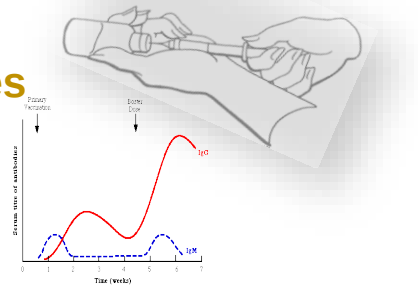


Infections
Deaths

OUTCOMES (related to direct and indirect effects / climate issue)

Higher Risk of immunosuppression & epidemics

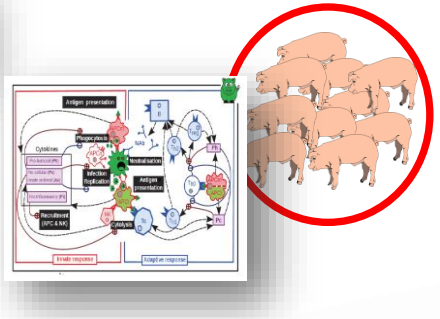
=> Improved Vaccines



✓ **New vaccine candidates, attenuated, recombinant, DIVA vaccines to monitor vaccine efficacy at large scale and to protect animals in control programmes based on biosecurity**

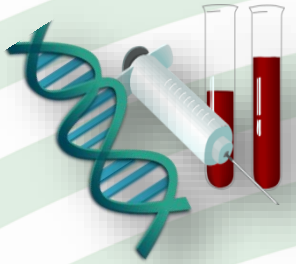
✓ **Adjuvants of specific types for species and age categories : neonates = the most sensitive !**

✓ **New knowledge in immuno-protective mechanisms + Mathematical modeling of vaccine risk and effectiveness crucial in case of epidemics**



Higher Risk of (a)biotic Stresses (infections, heat, food, water, …)

=> Improved health & robustness



✓ **Marker discovery + evidence of underlying genetic variability vaccine response / prediction of immunocompetence**

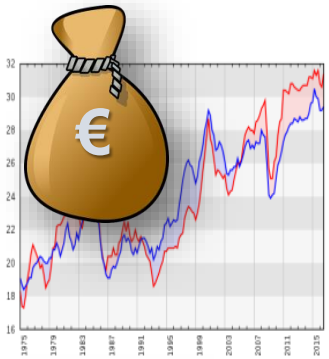
✓ **Identification of genetic markers and blood biomarkers of good and bad responders**

=> design of innovative breeding programs integrating improved health, robustness, adaptation

OUTCOMES (related to direct and indirect effects / climate issue)

Higher Risk of economic losses

=> Improved Socio-economic Models



✓ **Evaluation of the economic impact of the SAPHIR diseases**
= sound economic models which can be further enriched with
- environmental parameters
- other diseases

✓ **Prediction of the socio-economic benefits of using the designated health management (including vaccination) strategies**
include necessary changes of practices (farmers, breeders…)

LESSONS LEARNT FROM THE PROJECT

On « Research – Industry collaboration » & « climate issues »

- **Interdisciplinary project .... Beyond research-research but also research-industry**
  - Needs (communication) time to understand each other, openness, ”humility”
  - May/should change our views and explore new areas and ways of thinking

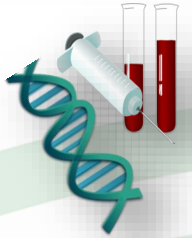
- **Involving industry & stakeholders:**
  - ≠ competitors as partners .... difficult even if “pre-competitive level”
  - Never enough ! co-building from the start .... before the start !

- **Implementation of the results : from research to a changing field**
  - Needs further validation....and access to more information

Ex. candidate biomarkers / genetic markers predictive of vaccine responses

Are there predictive of responses to other vaccines? In more stressing environments ?

=> to test on diverse genetics and environments



- **Difficulty to address a real « Integrated animal health management » level**
  - Building and validating integrated holistic environmental and systems approach
  - Including “pathogens” and “hosts” as animals in “production” systems”

RECOMMENDATIONS FOR R&I and PUBLIC POLICIES

Our common and ultimate goal should be:

"Improved sustainability and innovative capacity of the livestock sector in a changing world "

Support the

- ***R&I on the development of methods LINKING climate data with disease occurrence and further implementation of these applications to prevent and/or manage climate-associated diseases***
- ***R&I on tackling TOGETHER – climate change mitigation – innovative management of animal health & welfare***
- ***R&I on CRITICAL FACTORS: geographical diversity, farmers, practices... Social sciences !!***

Incentives on

- ***co-creation of Win-Win situations between all relevant actors***
- ***transparency (flow of information), trust and awareness***

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IMAGE
Innovative Management of Animal Genetic Resources

Image

Presented by Michèle Tixier-Boichard

www. Imageh2020.eu

https://twitter.com/*imageh2020*

Challenges addressed by IMAGE

Key findings of the 2nd global assessment of Animal Genetic Resources, FAO

✓**Livestock diversity : a source of resilience to face greater climatic variability**

✓**The adaptations of specific species and breeds to specific environmental challenges** need to be better understood.

✓**Gene banks make possible to save and distribute biological samples from a range of populations, from local to international breeds, with associated data**

Semen
Embryos
Stem cells…

Tissues

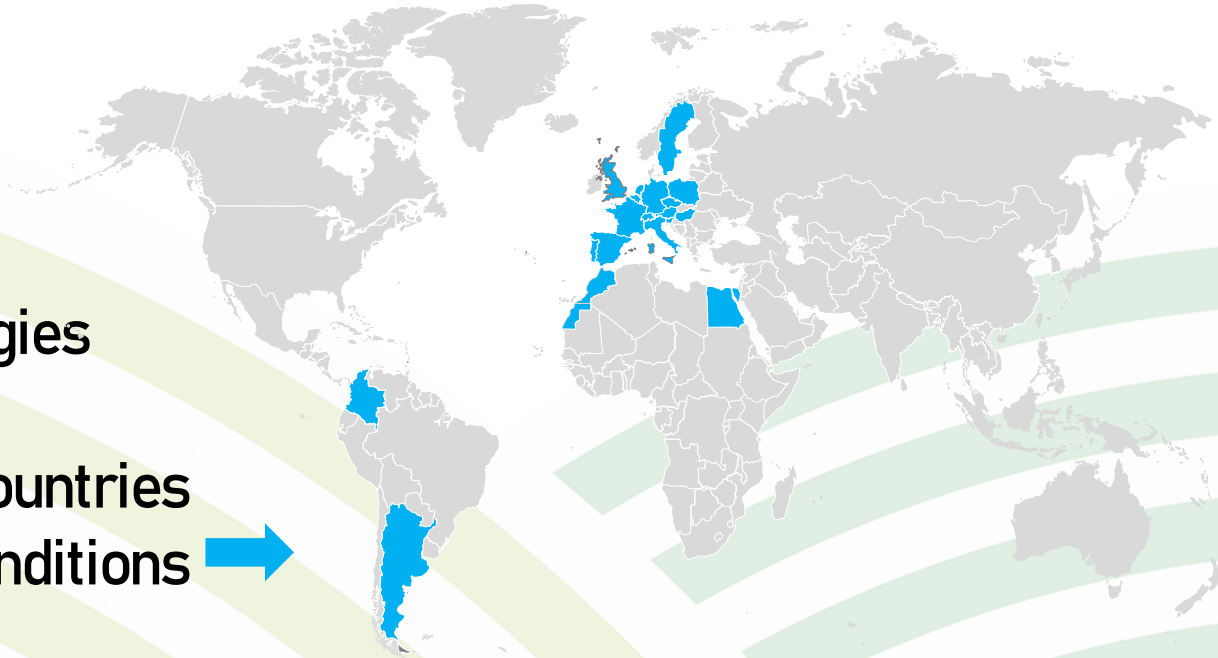
DNA…

Objectives of IMAGE

- to enhance the use of genetic collections
- to upgrade animal gene bank management
- to demonstrate the benefits brought by gene banks to allow the livestock sector to respond to new environmental constraints and market needs

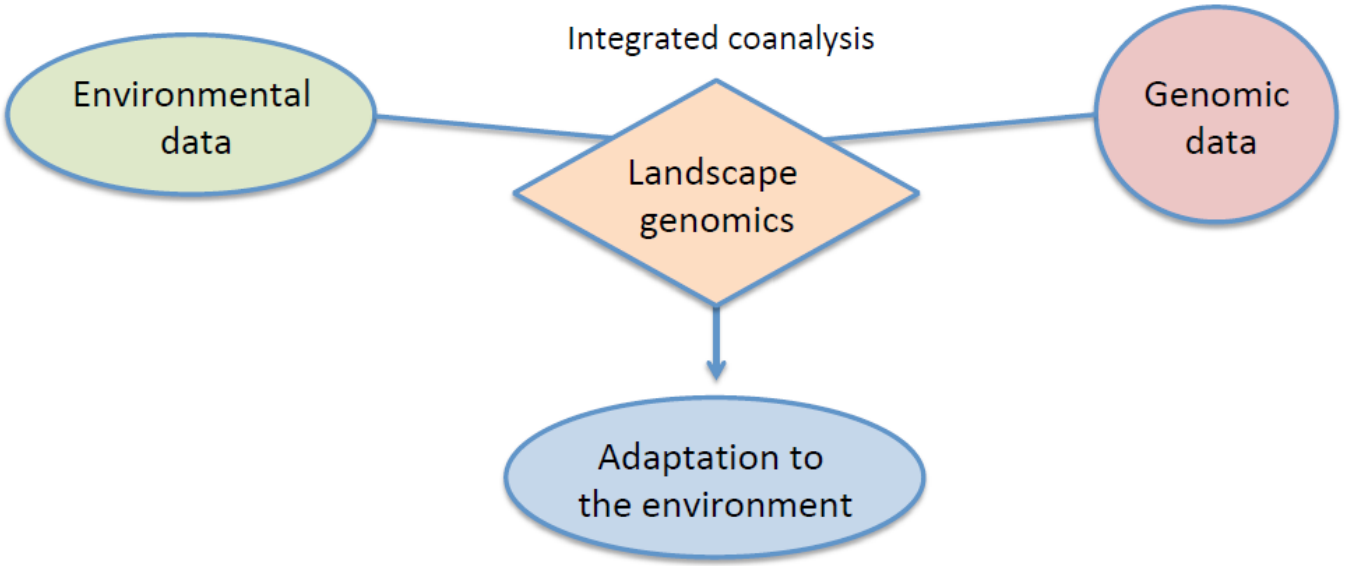
Through
genomics,
bio-informatics,
reproductive biotechnologies

A wide range of countries
and climate conditions



Outcomes: using gene banks to analyse adaptation to climatic variation by landscape genomics:

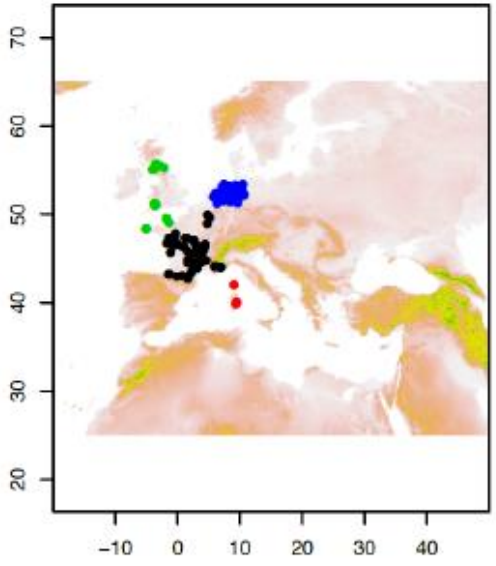
Goal: understanding **molecular mechanisms underlying livestock adaptation** to **environmental challenges**



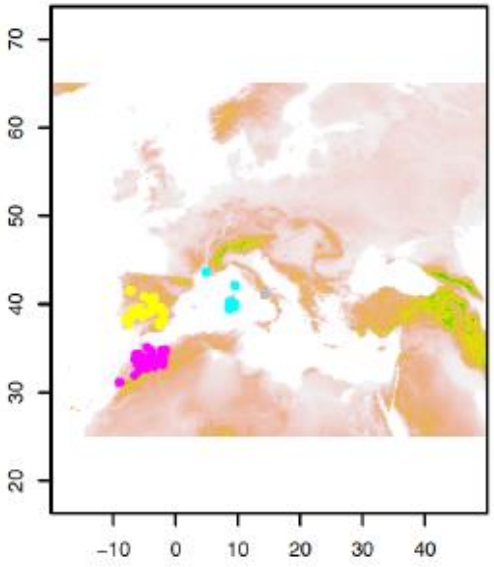
Pilot study on sheep breeds provided by gene banks of IMAGE partners

1,011 geo-referenced samples from 61 breeds, 19 bioclimatic variables
Exemples of 3 environmental clusters out of a total of 8 :

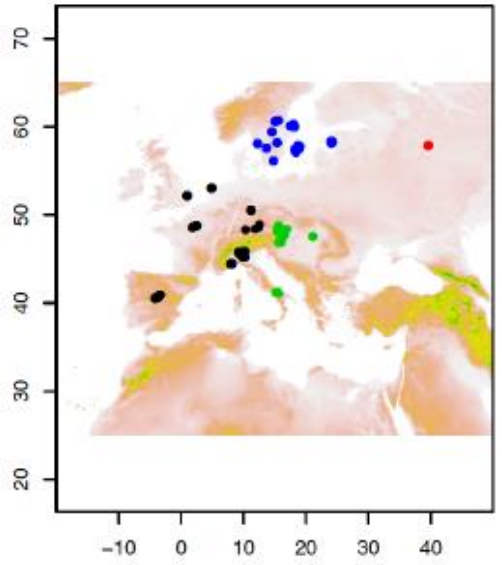
1 Continental - humid



2: Mediterranean - dry



3: Continental - cold



significant association between environmental variables and 44 candidate genes

Lessons

Gene bank collections are lacking molecular data

⇒ new data from IMAGE

⇒ new multi-species SNP chip to facilitate comparisons across gene banks

Data are not shared ⇒ IMAGE portal to be open // Biosamples of EBI infrastructure

A trusted regulatory framework is needed :

⇒ IMAGE review on Nagoya protocol for Access & Benefit sharing

⇒ IMAGE proposals for regulating new reproductive biotechnologies

Reproductive technologies need to be efficient in all species

⇒ IMAGE developed new protocols for chickens and pigs

Tools are needed to monitor the use of breeding material from gene banks:

⇒ IMAGE has developed a new software to simulate breeding programs

Recommendations

- ✓ National authorities need to officially **recognize national gene banks for conservation purposes** and set up specific measures to facilitate the use of gene bank materials.

- ✓ **More cooperation between European gene banks** should be supported

- ✓ **Gene bank collections need to be better documented** by increasing the available genomic and phenotypic data

- ✓ Initiatives for **introducing specific traits from genetic collections into commercial breeding programmes** should be supported in particular **for increasing the adaptation of current livestock populations** to different environments and changes in production systems

Fitter LiveStock Farming

Feed-a-Gene

Feed-a-Gene

Presented by Jaap van Milgen, project coordinator

www.feed-a-gene.eu

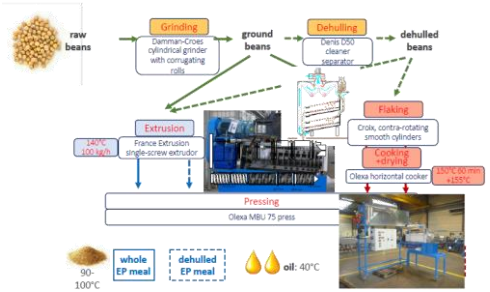
https://twitter.com/feedagene

Objectives of the project

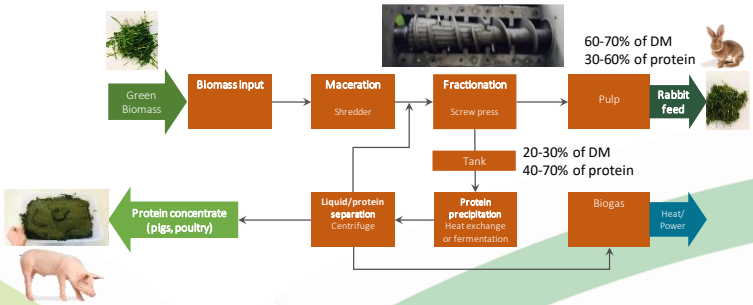
- Feed:
  - Develop new local feed resources that are not/less in competition with food
  - Improve the nutritional value of feed resources
- Gene:
  - Develop novel traits indicative for feed efficiency and robustness that can be used as selection criteria
  - “Do better with feeds that may be worse”
- Traits, models, and feeding techniques:
  - Appreciate variation among animals
  - Develop precision feeding techniques
  - Evaluate the overall sustainability

Diversify to increase protein autonomy

European-grown soybean



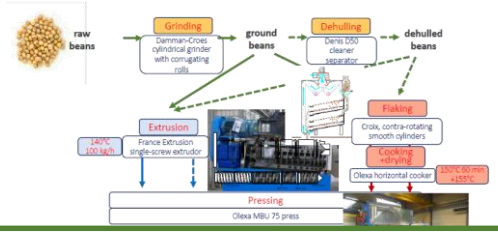
Protein from green biomass



Rapeseed meal

Diversify to increase protein autonomy

European-grown soybean



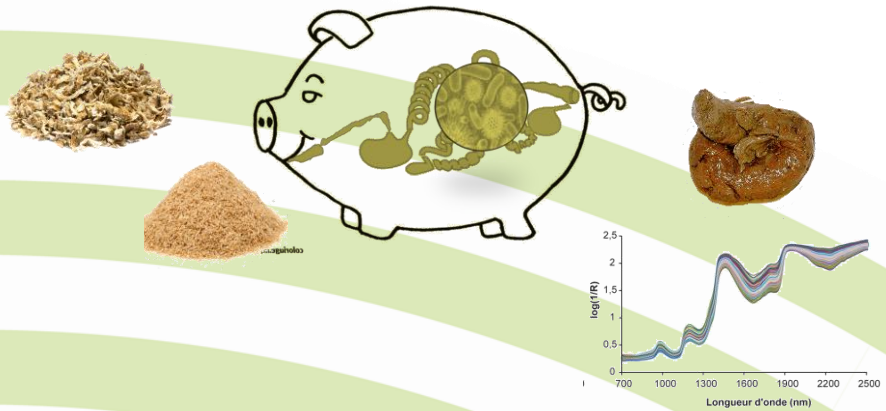
Compared to using Brazilian soybean meal, the use of alterative feed ingredients :

- reduces impact on climate change by 3-8%
- increases land use by 2-12%
- results in a transfer of impact (and responsibility)

Rapeseed meal

Explore and exploit the diversity among animals

digestive efficiency



1027 pigs

547
conventional diet

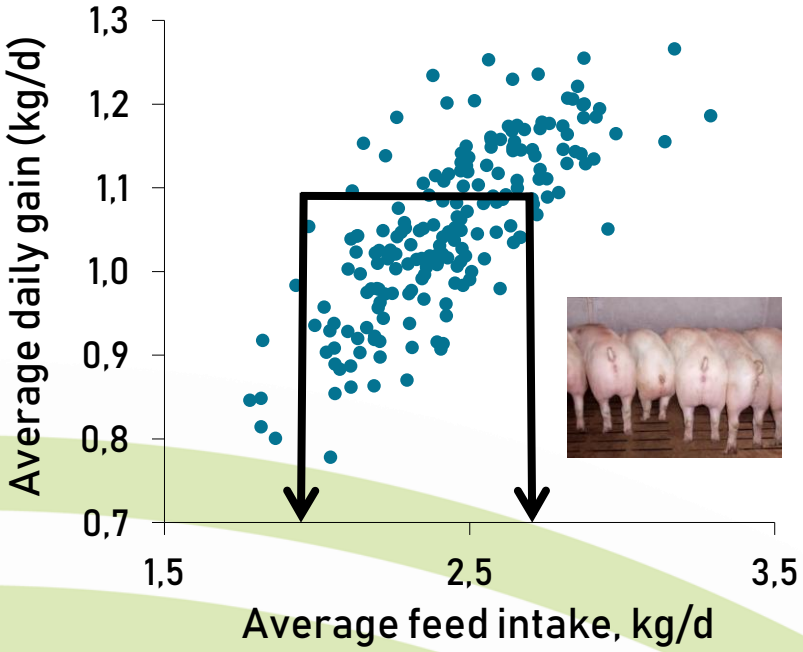
480
high-fiber diet

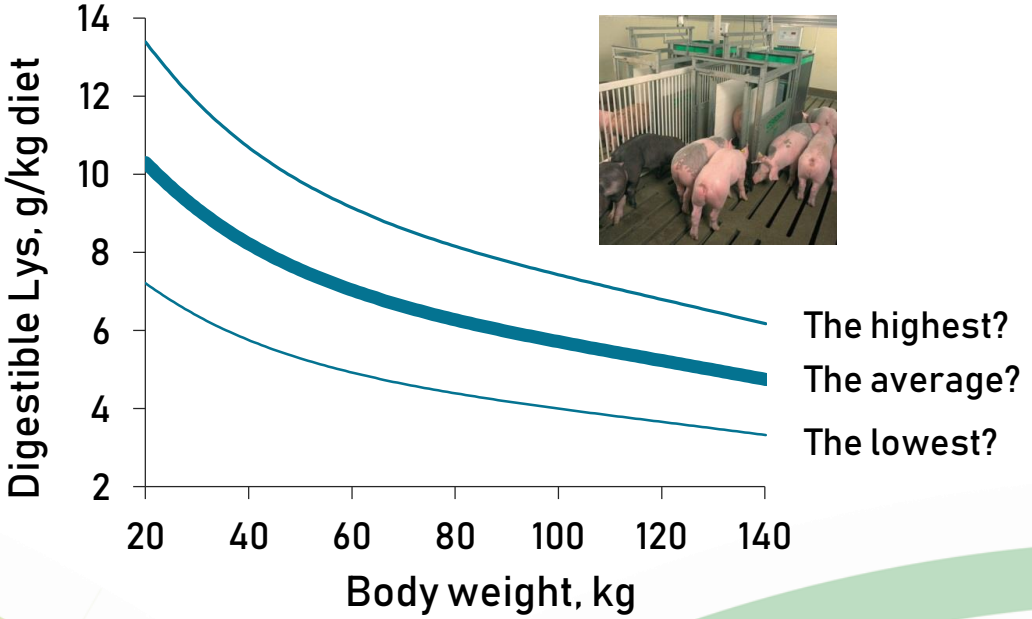
Explore and exploit the diversity among animals

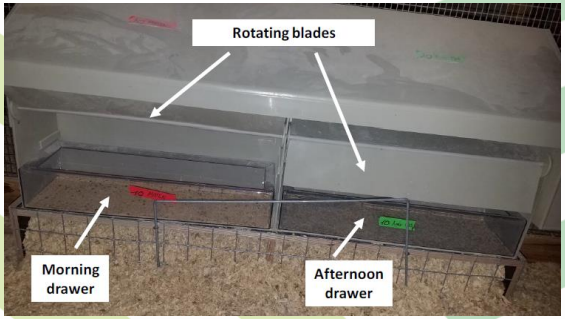
Digestibility is heritable (h^2 = 0.40-0.70), which offers opportunities for genetic selection:

- favorable correlations with feed conversion ratio, feed intake, and lean meat percentage
- unfavorable correlations with daily gain, carcass yield, and meat quality

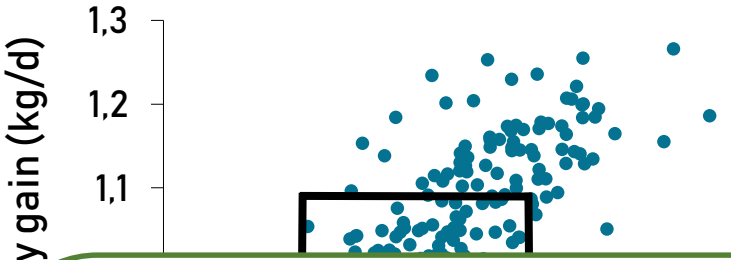
Which animal are you going to feed, and when?

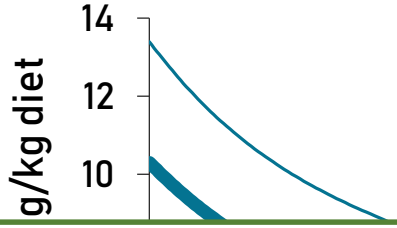






Which animal are you going to feed, and when?





Compared to conventional phase-feeding, precision livestock feeding:

- reduces protein use by:
  - 2% for group feeding
  - 17% for individual “à la carte” feeding
- reduces eutrophication and acidification by 3-17%

Lessons learnt from the project

- There is a potential to increase the efficiency and robustness and to decrease the environmental impact
- Multi-actor approach
  - It can be difficult to get industry on board
- Multi-disciplinary approach
  - It takes time to see across disciplinary borders
  - Focus on an object (vertical chain) rather than on a sector?
- Ensure cross-talk between projects
  - There has been a life before, and there will be one after …
- Allow for some open end
  - Some promises (deliverables) are programmed 5 years ahead
- The livestock production sector is communicating too little to society

Recommendations for R&I and public policies

- Combine data-driven and concept-driven approaches in data analysis and modeling: where black meets white
- Embrace variation and diversification: there is no “one-size-fits-all”
- Ensure integration of technologies in precision livestock farming; but is society ready for it?
- Reduce the gap between citizens and consumers through (better) communication

Fitter LiveStock Farming

GENTORE

Genomic management Tools to Optimise Resilience and Efficiency

Presented by Nic Friggens, project coordinator

www.gentore.eu

https://twitter.com/*GenTORE_H2020*

GenTORE Consortium

- 21 partners
  - 12 multi-actor
  - 9 academic
- 11 countries
  - Including major beef producing countries
- INRA, Teagasc, SRUC, FiBL, WUR, Aarhus, EFFAB, Allice, CITA, EAAP, FSK, Idele, InterBull, IT, LfL, New Medria, Noldus, RAFT, UDL, UniPadova, Viking Genetics
- Multi-disciplinary
- Multi-Actor Stakeholder involvement
- 5-yr project, started June 2017

GenTORE is:

- Seeking to exploit the opportunities provided by Genomics and Precision Farming Technologies
  - Highly complimentary disciplines
  - Strong synergy
    - If appropriately combined

- Developing:
  - Genomic selection for resilience and efficiency
  - Precision phenotyping for resilience and efficiency
  - Decision support tools for on-farm use

Applying genomics in the context of precision agriculture

- The combination opens up for:
  - Precision mating
  - Tailoring to local production environments

- Augmentation of genomic information with information on the animals phenotypic trajectory
  - Prior performance
  - Prior health events, etc.

Imagine the farmer can…

- Rank his animals on their probability of:
  - Reproductive success
  - Completing the coming production cycle
- Relativised to the local production environment
  - Herd as own control
  - Weighting of e.g. resilience vs efficiency

↓

- Breed the right number of replacement animals
- Diversify via cross-breeding the rest

↓

- ↑Farm-level efficiency = ↑Mitigation
- ↑Farm-level resilience = ↑Adaptability

Making it happen

- Scientific basis and proof-of-concept ☑
  - genomics of cross-breds
  - resilience and efficiency proxies
  - mapping climate risks of local production environments

- Incentives to spread use of genomics
- Incentives to facilitate incorporation of data from on-farm technologies
- Incentives to encourage practical use of decision support tools for reducing farm environmental footprint

GenTORE *@GenTORE_H2020*

Genomic management Tools to Optimise Resilience and Efficiency

www.gentore.eu

This project has received funding from the European Union's Horizon 2020 research and innovation program under Grant Agreement No 727213

Fitter LiveStock Farming

SmartCow

an integrated infrastructure for increased research capability and innovation in the European cattle sector

1/2/2018 – 31/1/2022

SmartCow

Presented by René Baumont (rene.baumont@inra.fr), project coordinator

www.smartcow.eu

https://twitter.com/cow_smart

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement n°730924

Concept and objectives of SmartCow

- Better coordination of research infrastructures (RIs) in the cattle sector is necessary to develop more efficient approaches to address the societal, environmental and economical challenges
- SmartCow is a first step towards the integration of RIs for the European cattle sector, developing:
  - ***Networking activities***: mapping RIs, adopting common language, the best standardized techniques and improving data sharing
  - ***Joint research activities***: improving gold standard methods in nutrition and behavior and developing 'proxies' to phenotype new and more complex animal traits
  - ***Transnational access:*** providing researchers an easy access to high quality services and resources

14 partners across Europe

9 partners that bring RIs

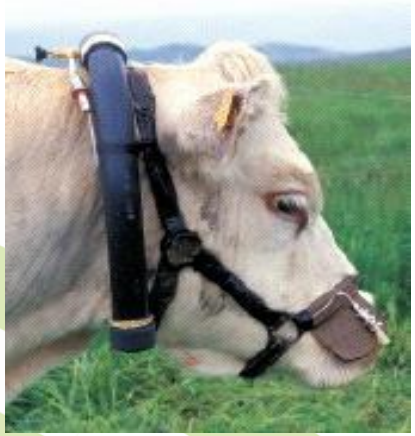
- 11 major RIs distributed in 7 EU countries
- 12 locations, which include 18 installations
- ≈ 2500 dairy and 750 beef cows
  - *Part of the animals are genotyped*
  - *Possible link with gene banks trough identification number*

5 other partners for specific skills

- Agrimetrics : Cloud based data-platform
- CRA-W : NIR and MIR techniques for phenotyping
- Idele and EAAP: Dissemination and stakeholders
- INRA Transfert: Project management

A large range of measurement capabilities in nutrition, physiology and behaviour

- In particular, consortium has excellent expertise in animal methane methodology
  - Six RIs have enclosed chambers
  - Seven RIs have capability using the SF6 technique
  - Eight RIs have the Green Feed technology



- FBN's temperature-controllable room to study heat stress

Outcomes of networking and research activities related to climate issues

- Book of methods in cattle physiology and behaviour
  - Chapter on methane emission
- Refine reference measurement methods of nutrient efficiency and emissions (CH4 and N), in particular :
  - Reducing uncertainty in methane emission measurements, through
    - Historical data bases of methane emission analyzed for sources of variation
    - Ring test of CH4 (and CO2) recovery for chambers
- Develop proxies (biomarkers) to predict nutrient efficiency, their determinants and emissions
  - Prediction of CH4 emissions from MIR in milk and NIR in faeces
- Develop a multivariate approach to phenotype behavioural, health and feed efficiency traits based on sensor data

Improve phenotyping capabilities and Implementation of 3R principles

Transnational Access to SmartCow RIs

- Budget to fund around 30 experiments proposed by industry/academics stakeholders in SmartCow RIs
- Project funds animal facility costs – such as animal care, monitoring, sampling & sample preparation
- Among the broad research priorities (feed efficiency, health…)
  - Mitigation options to reduce GHG and other emissions
  - Efficient and robust animals, adaptation to climate change
- First call in 2018
  - 10 projects accepted: 5 industry/5 academics;
    7 countries: UK, AU, FR, CH, DK, SP, DE
  - 1 project on reducing CH4 emissions using plant extracts
- 2nd call in 2019 : 16 proposals currently under evaluation
  - 2 proposals on heat stress
  - 2 proposals on reducing CH4 emissions
- 3rd and last call in 2020

Lessons learnt from the first 18 months of the project

- High interest of academic and private stakeholders to access to the best research infrastructures through transnational access procedure
  - Fostering innovation
  - Reinforced academic–industry partnership
- High interest of young researchers (PhD, Post-docs) for training courses on new methods and techniques developed in RIs
- Collaborations established outside the consortium (Global Research Alliance – Feed and Nutrition Network, SLU, LUKE, Agroscope,...) to strengthen research activities through the building of large databases
- Expression of interest from organizations and countries outside the consortium (Sweden, Poland, Israel, Portugal, Finland, etc.)
  - Enlarge the network of RIs for a advanced community infrastructure project

Recommendations for R&I and public policies

- The challenge of climate mitigation and adaptation needs :
- Phenotyping of complex animal traits
  - Strengthen our recording capacity of phenotypes using reference methods in RIs
  - Develop promising approaches based on biomarkers (proxies) and sensor data
- Multi-site and long-term studies
  - Large and networked RIs are necessary for multi-sites and long-term studies
- Moving towards effective solutions in the real life
  - Stronger stakeholder engagement to link studies conducted in RIs with on-farm studies

Fitter LiveStock Farming

Questions & Answers

Moderator: Vivi H. Nielsen, *ATF Vice-President for research providers (Aarhus University)*

Fitter LiveStock Farming - These projects have received funding from the European Union's Horizon 2020 (H2020) Research and Innovation programme under Grant Agreements: GENTORE - 727213; Feed-a-Gene- 633531; SAPHIR - 633184; IMAGE - 677353; GplusE - 613689; SmartClow – 730924.

Fitter Livestock Farming workshop

Fitter LiveStock Farming

atf

GE PLUS

- Sustainability i dairy production
- Biomarkers in milk for detection of metabolic imbalance
- MIR based milk biomarkers for selection for robustness

SAPHIR

- Vaccine strategies reduce antibiotic use
- Test of 6 vaccines for pigs, cattle and poultry
- Regular vaccination is beneficial
- Genetic and bio-markers associated with immune response to vaccines for selection

IMAGE
Innovative Management of Animal Genetic Resources

- Conservation and management of biological resources for breeding and genetics
- Access to data and exploitation of collections from gene banks

Food security

Climate change mitigation

Sustainable agriculture
Environmental
Economic
Social

Minimize
Environmental impact

Feed-a-Gene

- Monogastic livestock production
- Alternative feeds and new technologies
- Improve efficiency and reduce environmental impact
- Selection for robust animals

GENTORE

- GENomic management Tools to Optimize Resilience and Efficiency
- Innovative genome enabled selection
- For different and changing environments

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

- Integrate key European cattle research infrastructures
- Covering all the relevant scientific fields and the diversity of cattle types and production systems
- Coordinated use

Fitter LiveStock Farming

Thanks for your attention

GENTORE

Developing genome-enabled selection and management tools to enable farmers to optimize cattle resilience and efficiency in a range of different and changing environments
gentore.eu

Feed-a-Gene

Adapting feed, animal and feeding techniques to improve the efficiency and sustainability of monogastric livestock production systems.
feed-a-gene.eu

SAPHIR

Strengthening Animal Production and Health through vaccine strategies against endemic pathogens responsible for high economic losses in livestock.
h2020-saphir.eu

GPLUS

Providing sustainable solutions to improve dairy cow selection and management through genomic selection and novel management protocols based on the development and exploitation of genomic data
gpluse.eu

IMAGE
Innovative Management of Animal Genetic Resources

Enhancing the use of genetic collections to upgrade animal gene bank management, gathering, storing and documenting genetic collections for research and breeding.
imageh2020.eu

SmartCow

Increasing R&I in the European cattle sector through an integrated infrastructure that combines strong scientific and technical skills in animal nutrition, genetics, health and welfare.
smartcow.eu

Common Dissemination Booster

These projects have received support from the European Commission's Common Dissemination Booster