

Antoine Hubert



Ynsect France

Antoine Hubert is president and co-founder of Ynsect, an innovative company focused on insect genetics, insect zootechnical studies, insect biochemistry and products characterization, process engineering and sustainable value assessment.

Hubert was previously senior scientist at Total and Altran, where he managed programs on sustainable development applied to bioresources, soil remediation, waste-to-energy and recycled resources.

In 2007, he launched the non-profit WORGAMIC, which deals with food sustainability, urban agriculture and organic waste recycling.

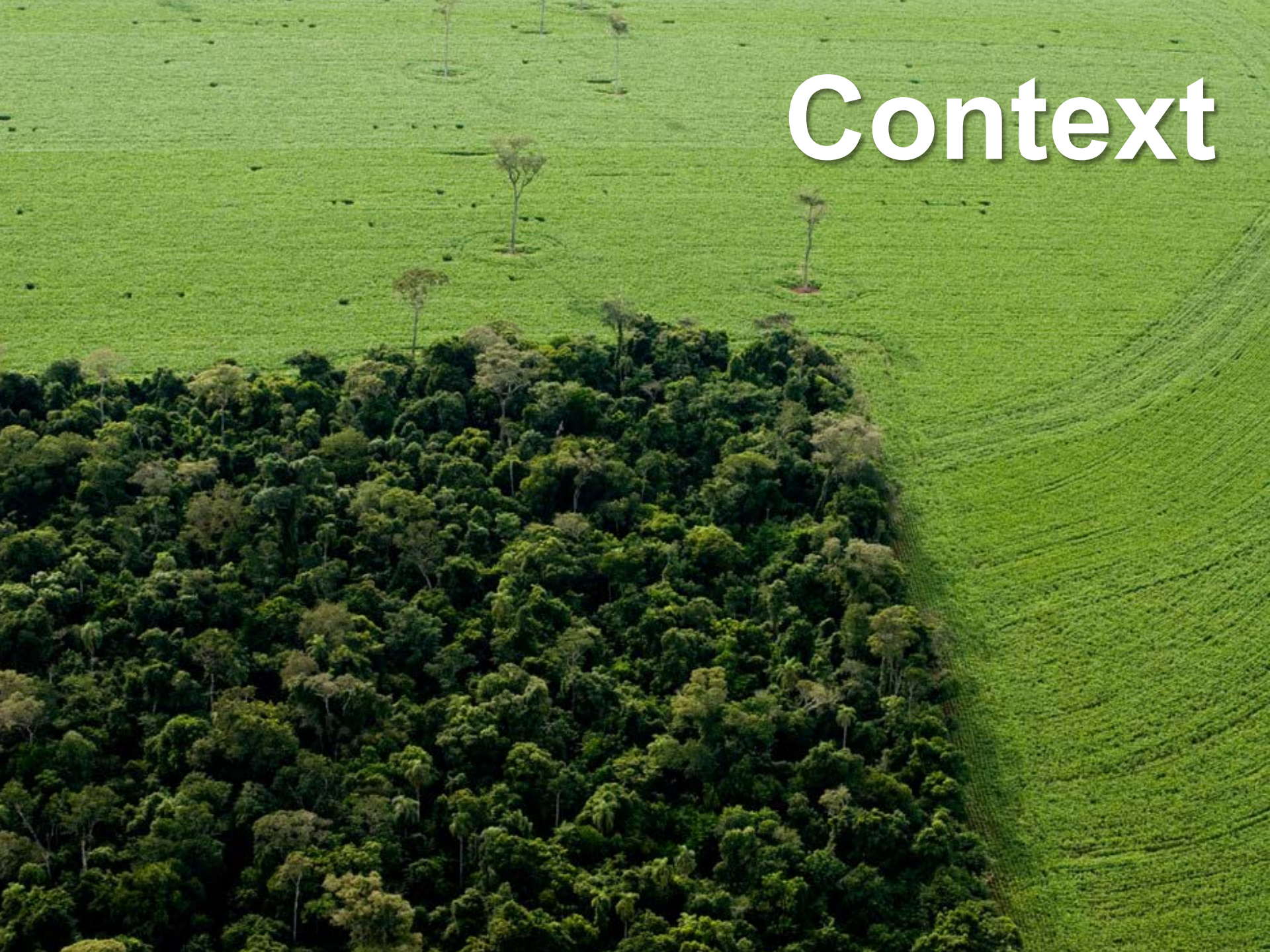


Potential of Alternative Protein Sources: Focus on Insect Meal

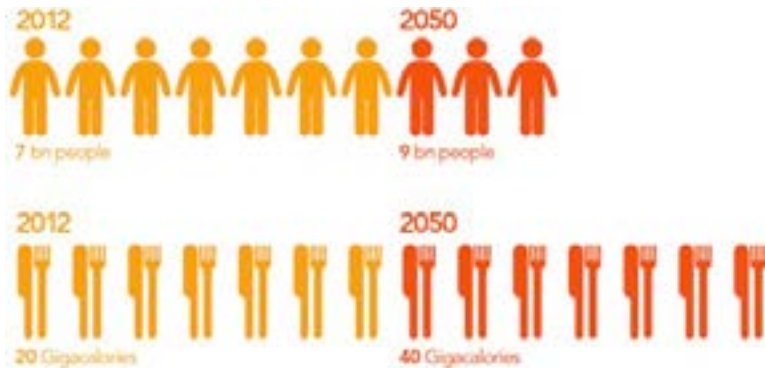
Antoine Hubert

**President
Ynsect**

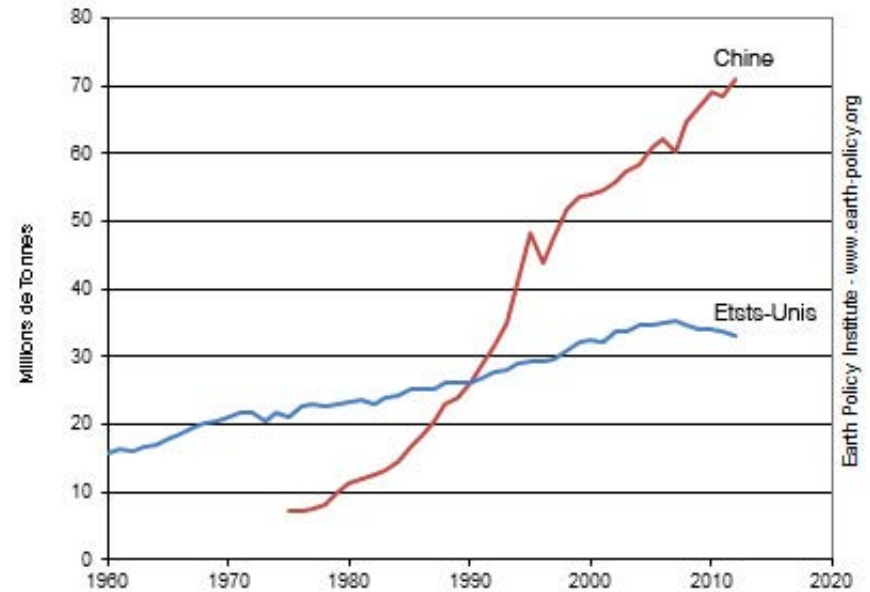
Context



The increase of population...



Meat consumption in USA and China
1960-2012



Source: USDA

Earth Policy Institute - www.earth-policy.org

France consumption from 1950 :

- meat x 2
- cereal / 3
- leguminous / 7

... leads to great challenges for feedstock industries



Non-sustainable feed raw material



Importation security



Forest biodiversity



Oceans biodiversity



Soja meal



Fish meal



Feedstock



Feedstock residues polluting environment



Eutrophisation

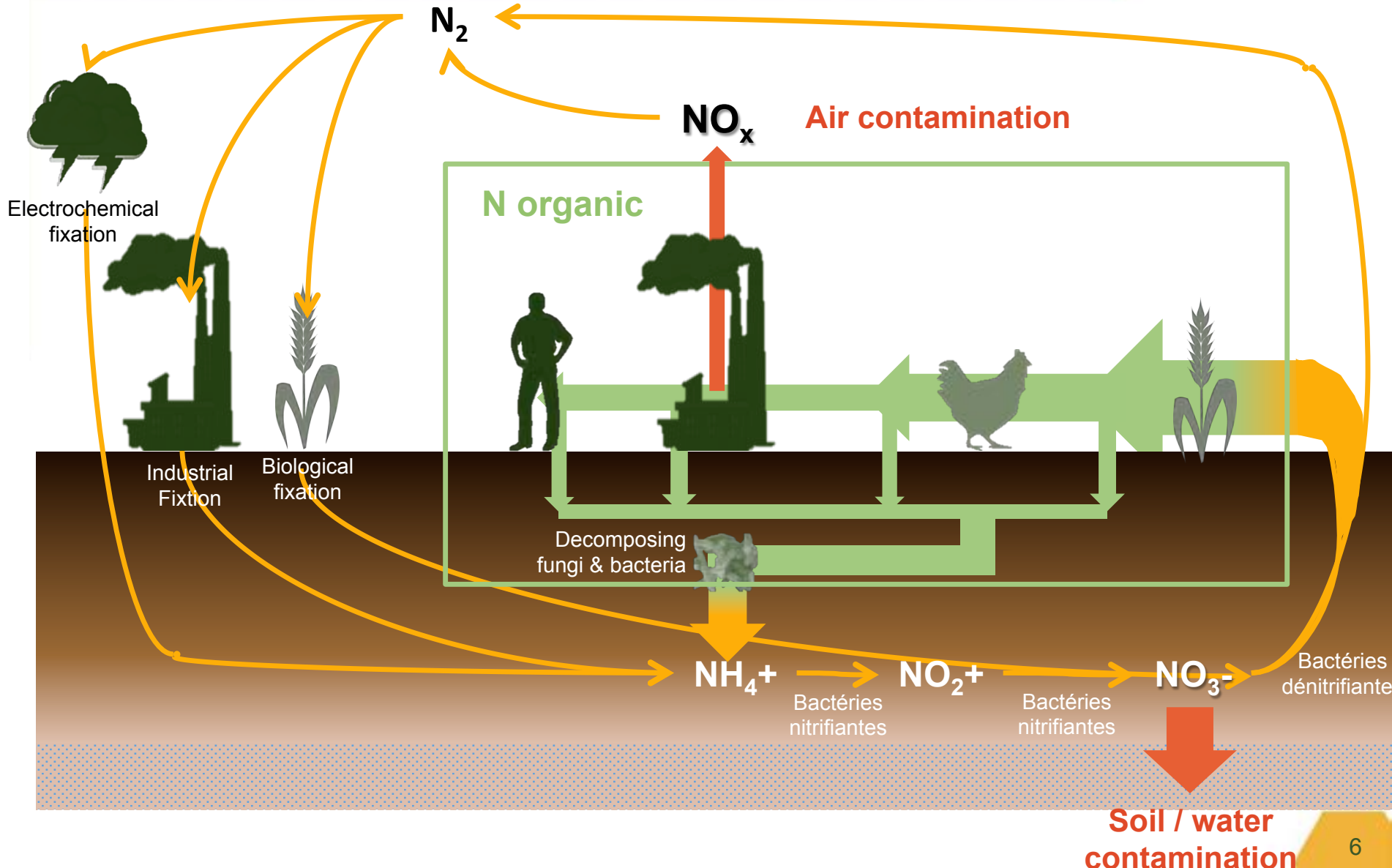


Soil



Potability

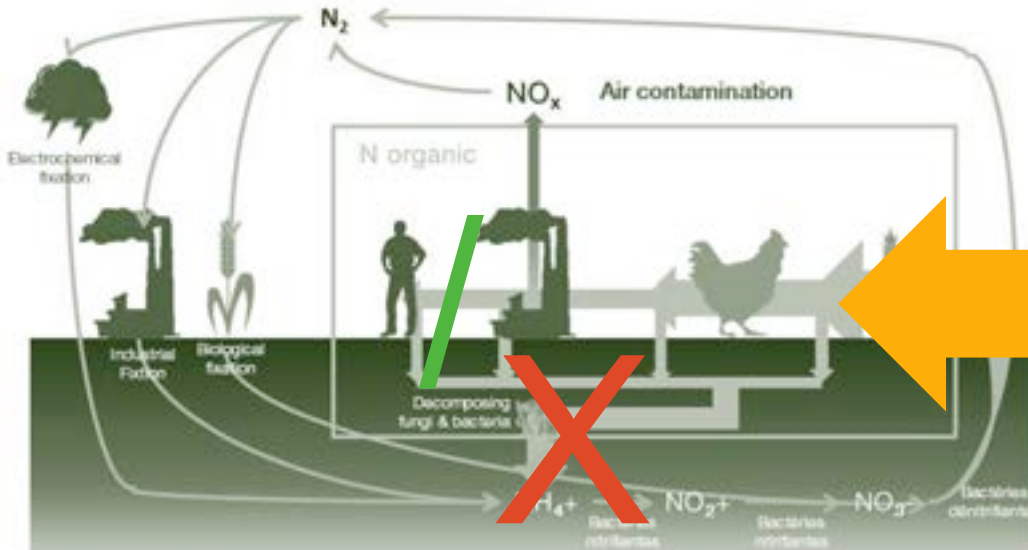
An issue of nitrogen flows and stocks



Which solutions to **increase protein availabilities** ?



(1) Consuming less resources



(3) Increasing protein production (fixation and assimilation of nitrogen)

2) Optimizing available resources to decrease nitrogen spillage / wasting

(4) find new resources out of current cycle



Solutions goes through **resources** **diversification**



2

3



Insects

2

3



Algae

4



Krill

A man wearing a red t-shirt and a blue cap is crouching on the grassy bank of a pond. He is holding a large black plastic bucket filled with dark brown feed pellets. His right hand is reaching into the bucket, and he is about to throw the feed into the water. The pond is filled with many small, dark fish that are swimming and feeding. The background shows green grass and some trees.

Insect for Feed markets



Insects are 1st worldwide biodiversity (except bacteria)



Selected model species



Mammals

5,600 species estimated
5,501 (98%) species discovered



Birds

10,500
10,064 (96%)



Reptiles

12,000
9,547 (80%)



Amphibians

15,000
6,771 (45%)



Fish

45,000
32,400 (72%)



Crustaceans

150,000
47,000 (31%)



Mollusks

200,000
85,000 (43%)



Arachnids

600,000
102,248 (17%)



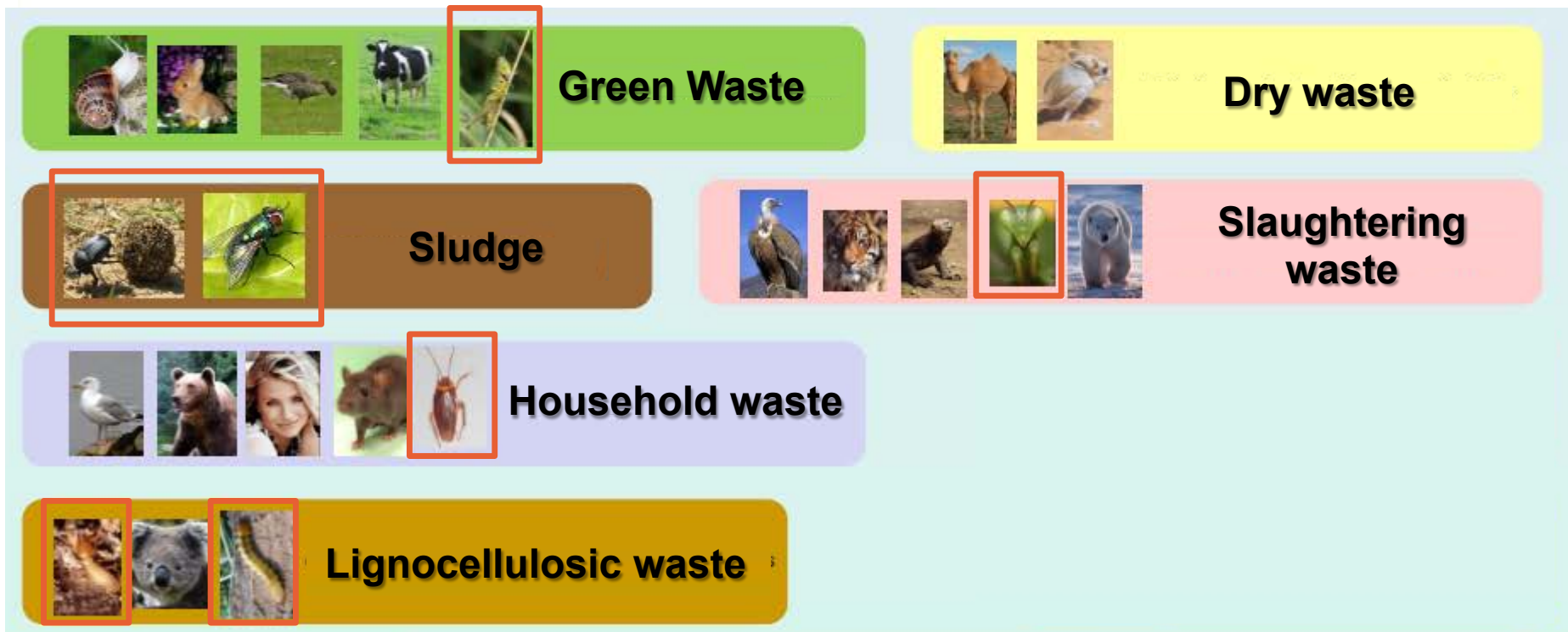
Insects

5,000,000
1,000,000 (20%)

Insects do have **all diets for all organic matter bioconversion**



From 5 to 200 millions years of « research » on digestion / bioconversion process



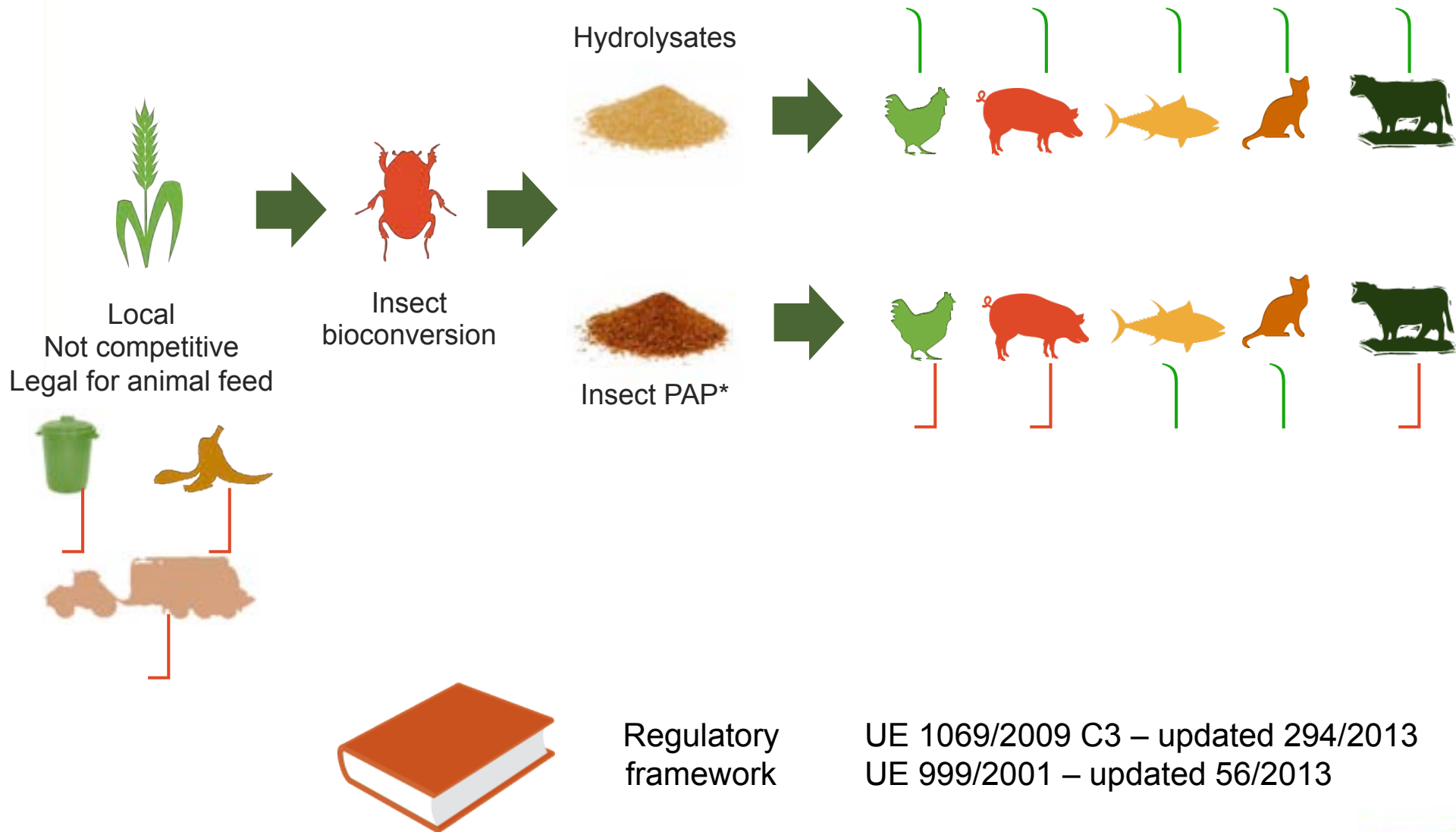
Source : ANR DANAC - INRA LBE

A potential good market acceptance thanks to actual use in pet food & naturality argument



Insect & PAP => low acceptance in Europe

Positive regulatory framework for the use of insect meals for animal feed in Europe



Insect meal composition

Exemple of Molitor PAP



Whole insect meal

Composition	P1	Unit
Dry matter	93.44	g / 100 g
Ash	3.16	g / 100 g
Lipid	28.02	g / 100 g
Proteins	50.70	g / 100 g
Total carbohydrate	11.56	g / 100 g

Source : Ynsect 2013

Defatted insect meal

Composition	P3	Unit
Dry matter	91.90	g / 100 g
Ash	2.27	g / 100 g
Lipid	19.64	g / 100 g
Proteins	60.60	g / 100 g
Total carbohydrate	9.39	g / 100 g

Source : Ynsect 2013





Industrial aspects

Technical constraints for use as fish feed



Good nutritional profile especially **protein profile**
But **high content in chitin**

⇒ Reduce insect meal digestibility

⇒ Good digestibility till **30% incorporation** (Turbot)

When chitin separated => digestibility > 95%

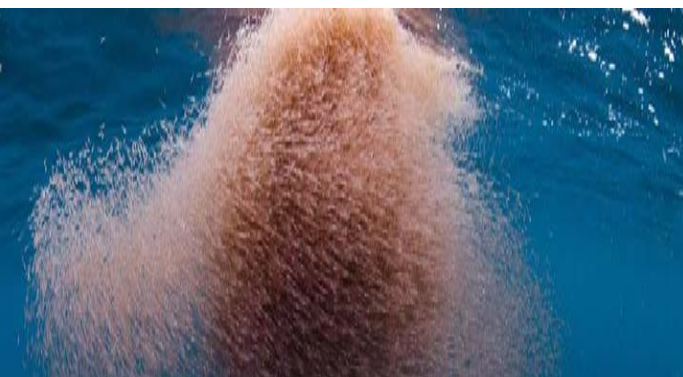


Good nutritional profile especially **lipid profile**
But **high content in polysaccharides**

⇒ Reduce algae meal digestibility

⇒ Good digestibility till **40% incorporation** (Tilapia)

When polysaccharides separated => digestibility > 95%



100% fish meal substitution by **krill meal** in diet without growth modification (Cod & Rainbow Trout)

But **high fluoride content** (1 000-6 000 mg/kg) + UE directive limitation + **chitin content**

⇒ **5 to 10 % incorporation** limit / palatability properties



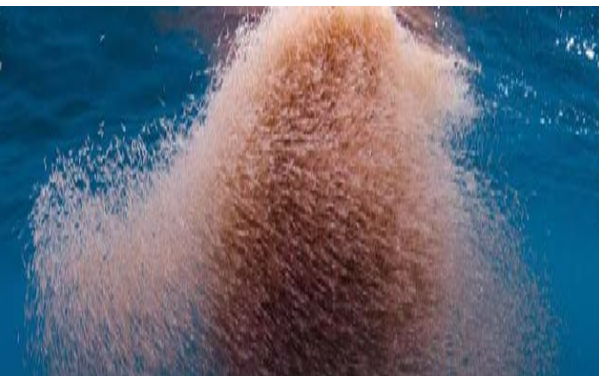
Current world production & prices and potential in 2020



COMMODITIES



MOLECULES
(PIGMENTS, DHA, EPA)



2013

3000 T
(30 000T)
3000 –
6000€/T

15 000 000 T
500 –
9000€/T

10 000 T
3000 –
20 000€/T

300 000 T
1000 –
10 000€/T

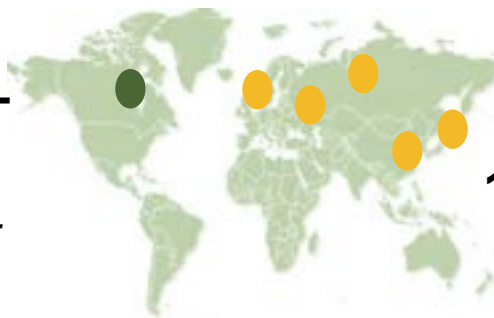
2020

**30 000 –
100 000 T**
1000 –
2500€/T

> 20 000 000 T

**50 000 –
100 000 T**
1500 –
10 000€/T

**500 000 –
1 000 000 T**



Conclusions



Conclusions

Proteins / Energy, same issues !



Protein needs very important
& limited traditional resources

⇒ **Protein transition**

No miracle solution !

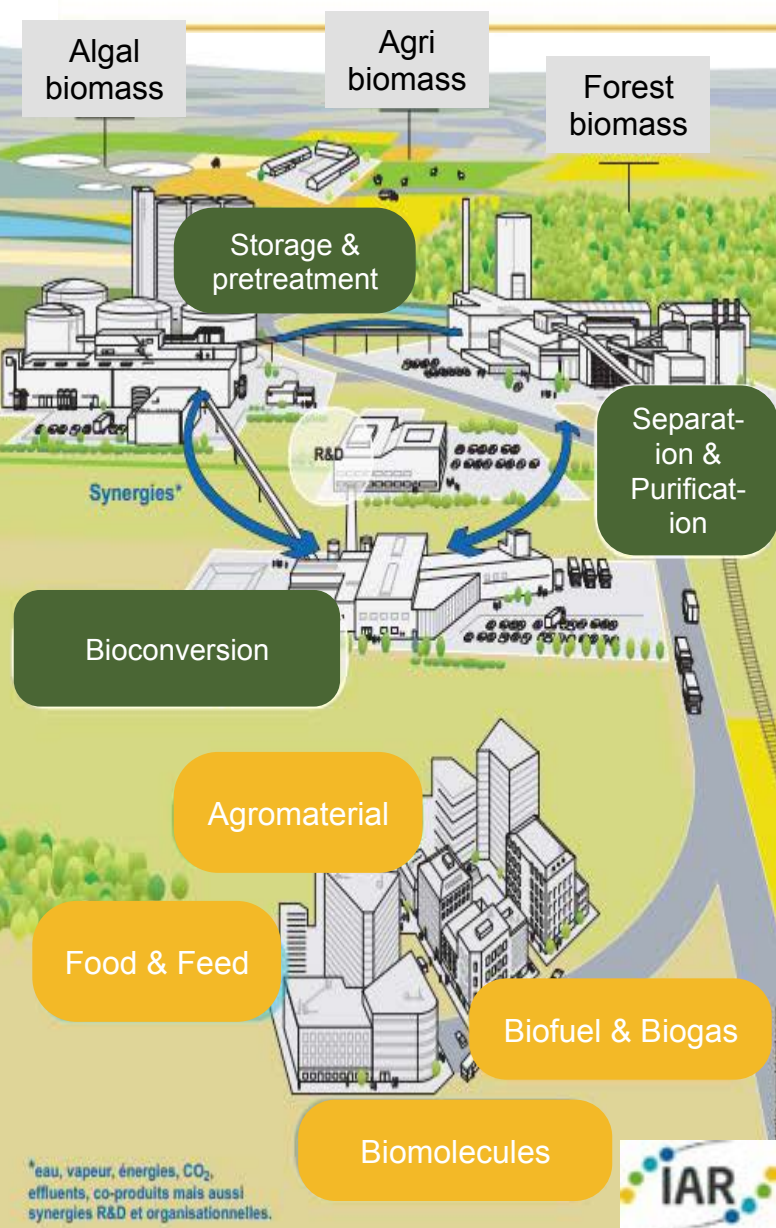
⇒ **Smart feed grid**

⇒ **Protein mix**

**Still a long journey for sustainable and affordable protein
sources**

⇒ **from molecules / niche market
to commodities / mass market**

Insect, microalgae and krill represent serious **alternative feed sources**



- Already used as complement (5-10%) for some fish species
- Source of oil too (algae)
- But
 - **Prices still too high** compared to fish feed
 - **Quotas** issues for krill
 - **Farming challenge** for macro-algae
 - **Competition** with food
 - **Anti-nutritional factors issues** (polysaccharides, fluoride...)

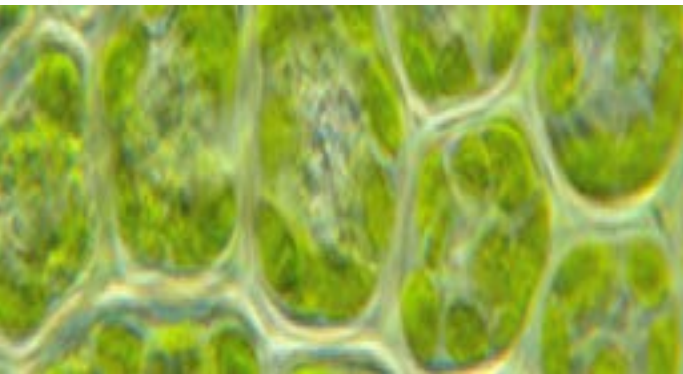
⇒ For bigger incorporation, **need for cost efficient separation technologies**

⇒ **Decreasing meal prices with byproducts valorization + capacities scale-up**

⇒ **From Agriculture & Fisheries to Biorefinery**

*eau, vapeur, énergies, CO₂, effluents, co-produits mais aussi synergies R&D et organisationnelles.

A progressive scale-up & industrialization backed up with powerful R&D is the key to success in this journey



ProteInsect



WAGENINGEN UR
For quality of life

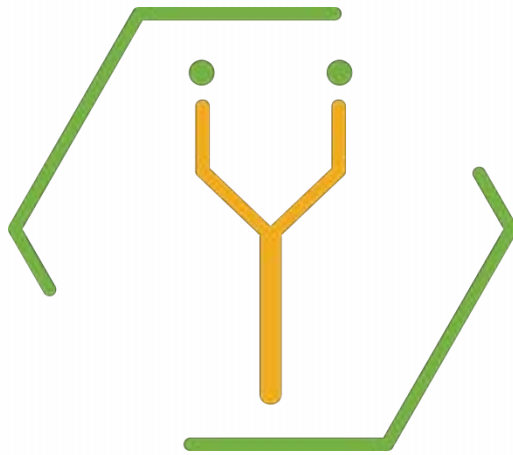
Supro2

Desirable
insect biorefinery



Industry development goes through **cooperation** :
Producers start to get united for **regulation lobbying**,
communication and **R&D joint efforts**





Insect Biotech Pioneer

Providing innovative products
& services from insects

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