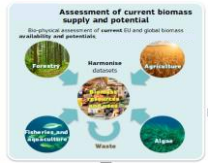
MarineBiotech

Biomass production and processing



ERA-MBT Final Conference: 'Oceans of opportunities'
Oslo, 19th November 2017

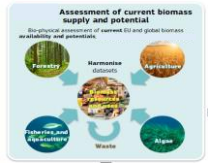
Dr. Johan Robbens PhD MBA
ILVO - Institute for Agricultural and Fisheries Research
Ostend, Belgium

ILVO
Instituut voor Landbouw- en Visserijonderzoek

MarineBiotech

Biomass production and processing - what's the way forward

Johan Robbens



Case Jon Funderud
'From fuels to food… and back again
– a case study of seaweed biomass'

Seaweed Energy Solutions AS, Norway
CEO Jon Funderud

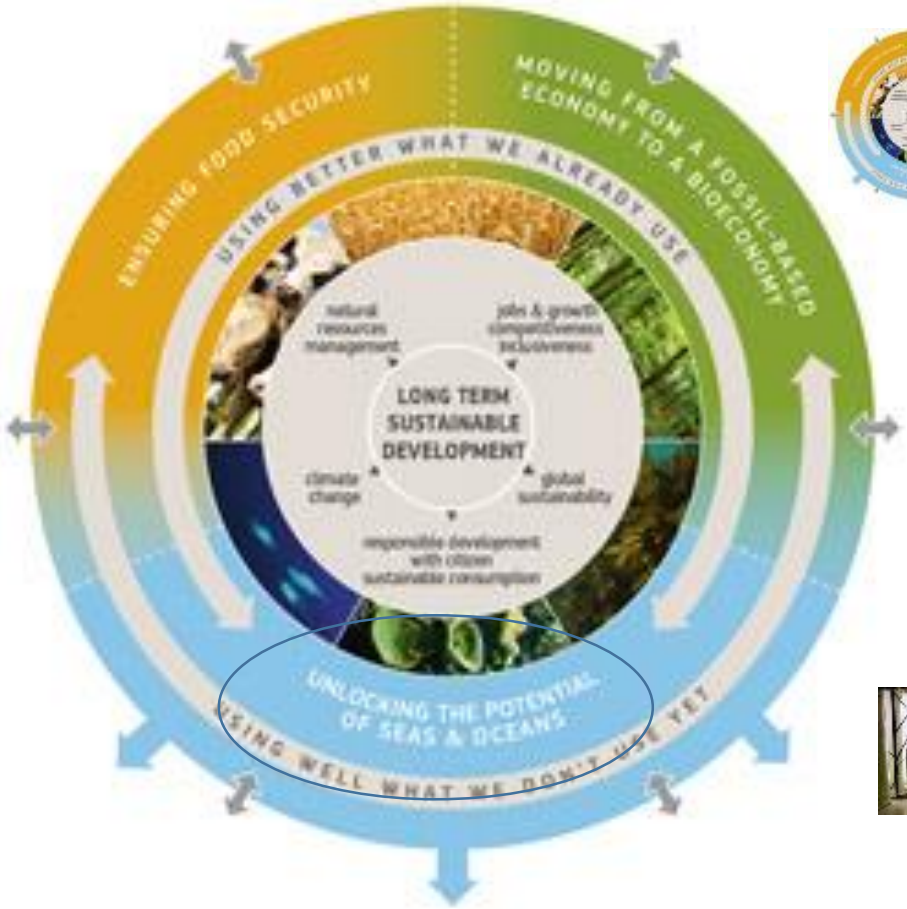
ILVO
Instituut voor Landbouw- en Visserijonderzoek

MarineBiotech

The Good Momentum!

H2020 Week and
BioEconomy Policy Day/Blue Growth & Innovation
Last week - Brussels

EU-BioEconomy Strategy
'Unlocking the potential of Seas and Oceans'



European Bioeconomy Stakeholders
Manifesto
Launched 16 Novembe 2017

+ BBI
*Blue Bioeconomy and Marine Biomass should be aspect of that

ILVO
Instituut voor Landbouw- en Visserijonderzoek

Momentum

H2020 Week and Blue Bio-Economy

EU-Strategy
'Unlocking the potential of Seas and Oceans'

European Bioeconomy Stakeholders

Manifesto- Launched 16 November
Aim: to recognize the opportunities and Challenges of BioEconomy
…. and to include in different (EU)policy initiatives, FP9….

+ BBI
*Blue Bioeconomy and Marine Biomass should be aspect of that

MarineBiotech

Momentum

H2020 Week and Blue Bio-Economy
EU-Strategy

'Unlocking the potential of Seas and Oceans'

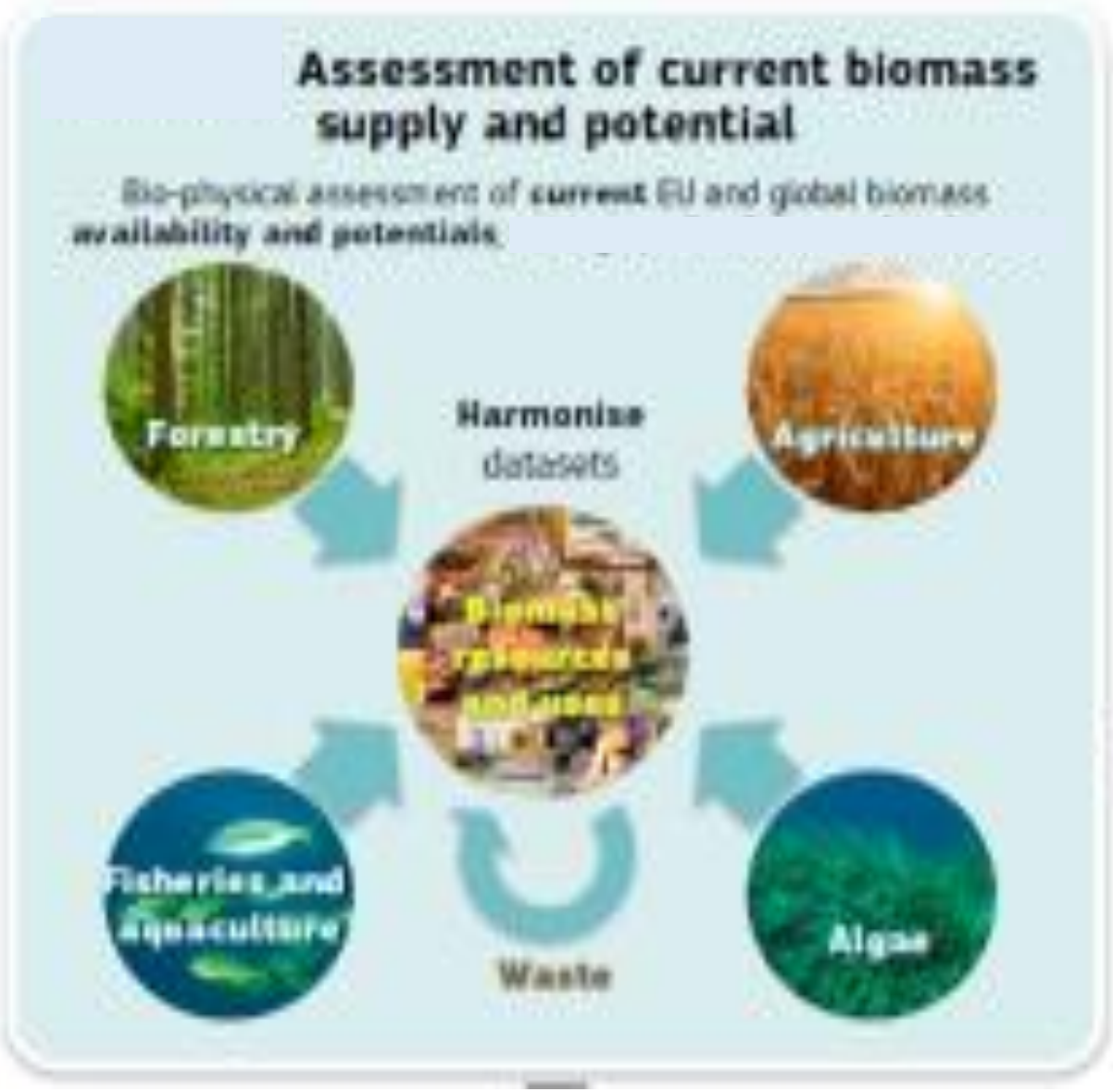
European Bioeconomy Stakeholders
Manifesto- Launched 16 November

Aim: to recognize the opportunities and
Challenges of BioEconomy
…. and to include in different
(EU)policy initiatives, FP9….

BBI

'Blue Bioeconomy and Marine Biomass should be aspect'
'… that and each year more blue projects….'

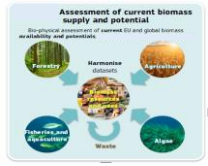
ILVO
Instituut voor Landbouw- en Visserijonderzoek

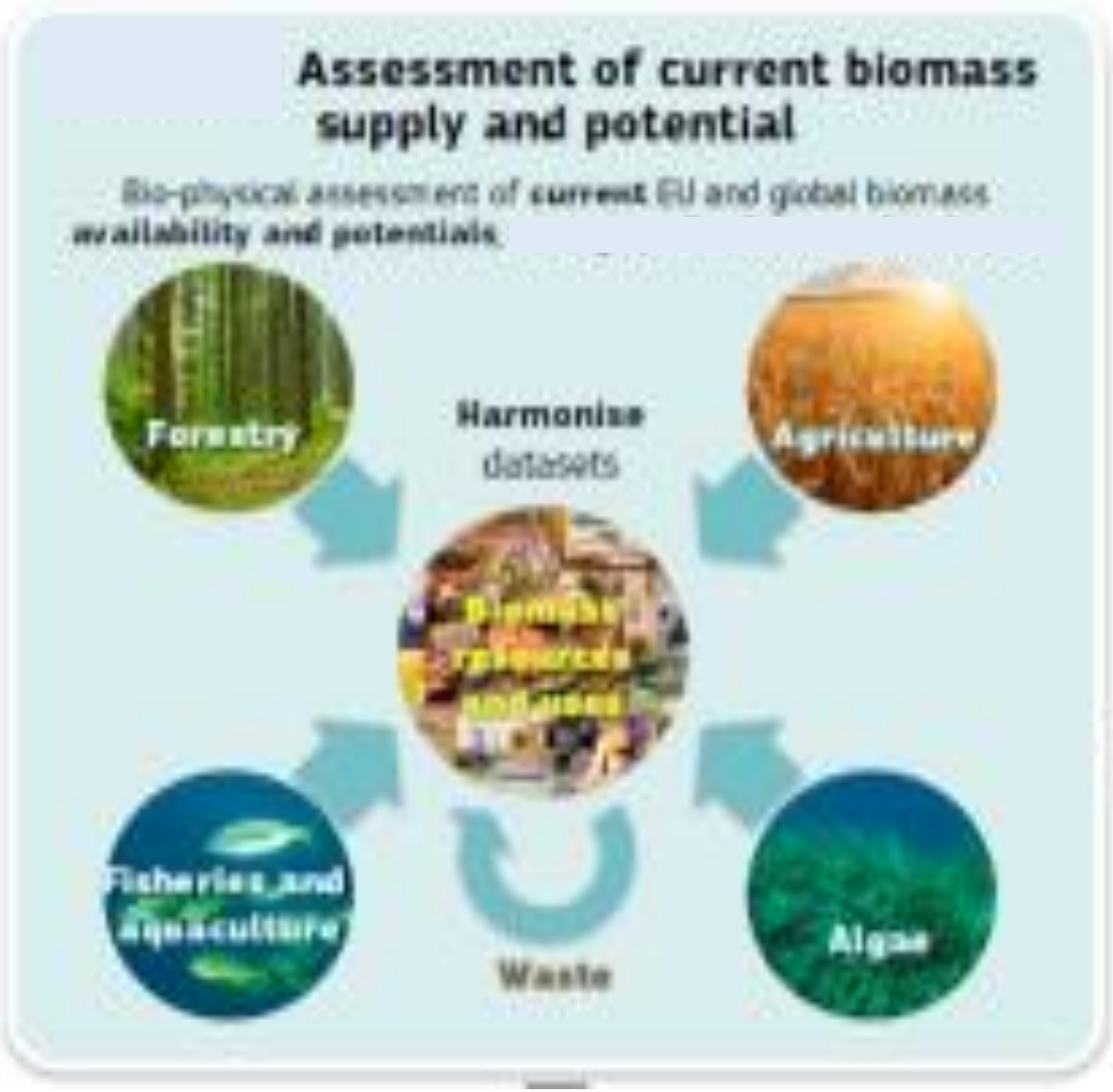


Source: JRC BioMass Assessment Study

Marine Biomass

- **Algae**
- **Fisheries**

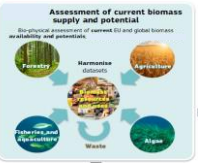




Source: JRC BioMass Assessment Study

Marine Biomass

- **Algae**
- **Fisheries**



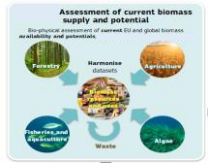
Eranet Roadmap Marine Biotech
'Marine Biomass relevant for Marine Biotech'

- **Aquaculture products – Algae**
- **Fisheries**
- **Marine Invertebrates** (cfr insect)
- **Marine Micro-organism**

Eranet Marine Biotech Roadmap

BIOMASS PRODUCTION AND PROCESSING

The main sources of marine biomass are species harvested from the wild and those that can be cultured. Securing sustainable marine biomass presents challenges, particularly if the sole source is from wild stocks, where overexploitation can threaten marine biodiversity as well as future supply of the target species. The strategic management of wild species coupled with plans to deliver more coherent and effective species management are essential if wild stocks are to remain viable sources of biomass and ecosystem health and services are to be maintained. Consistency, security and quality of biomass supply have to be balanced in ways that address environmental challenges and demands for sustainability. The well-managed and controlled culture of marine biomass, whilst similarly facing production challenges, offers sustainable sources of biomass.



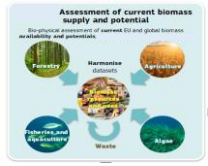
BioMass Algae- MicroAlgae and Seaweed

Valorisation

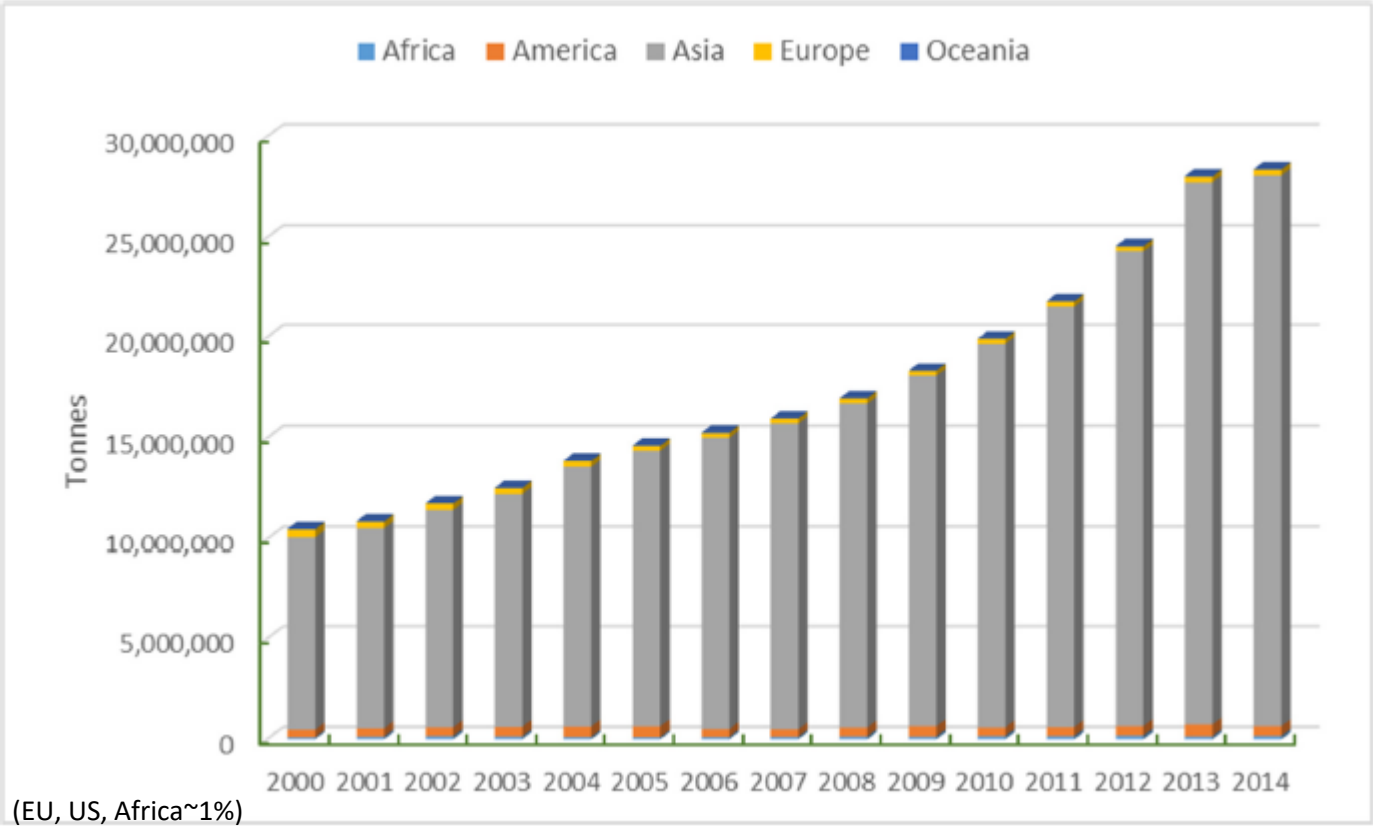
Food

Biorefines/bioactives

- Chemicals
- Neutraceuticals
- BioEnergy



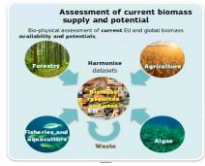
Seaweed in the BioEconomy

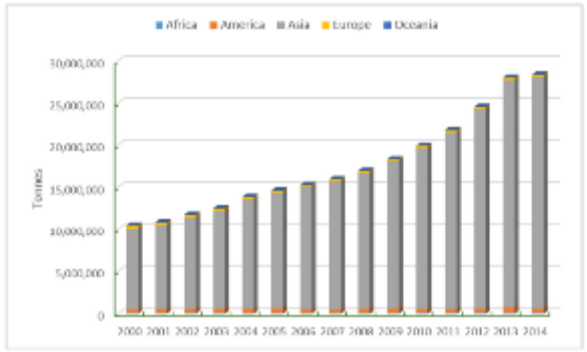


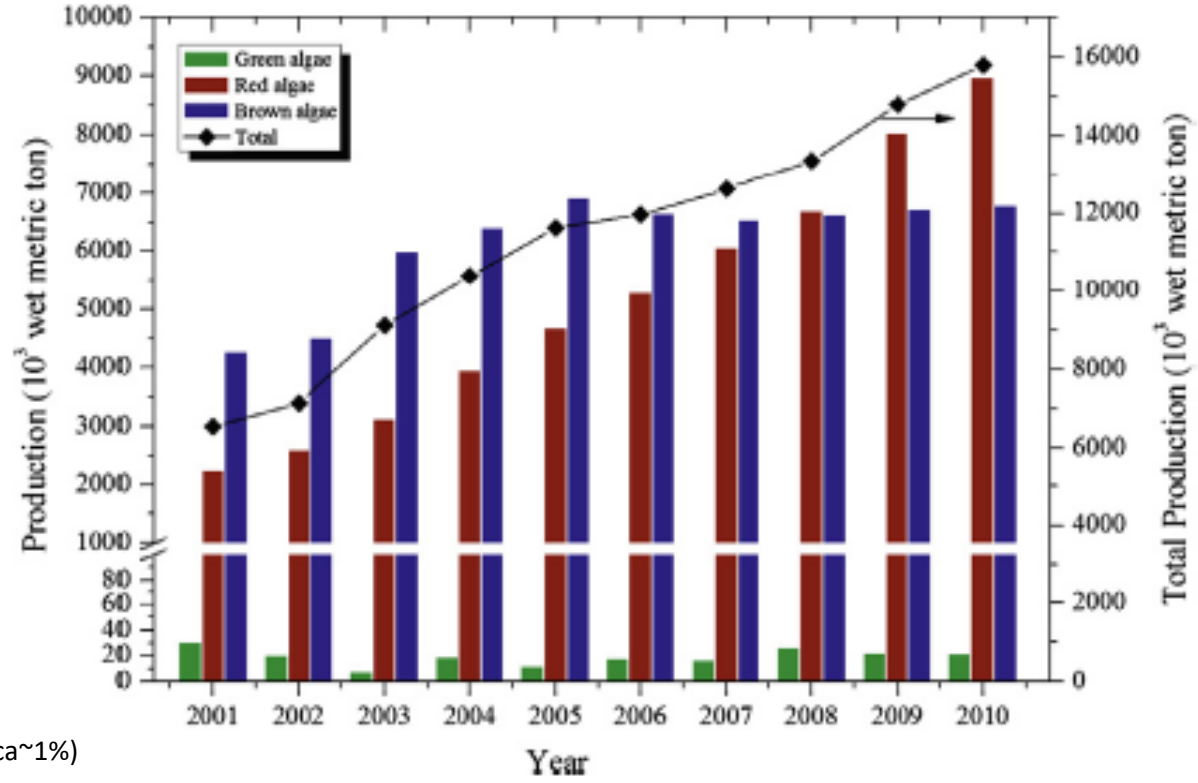
(EU, US, Africa~1%)

Source: Seaweed in the UK and abroad- CEFAS

Seaweed production
80% is related to human consumption
Food or flavouring compounds



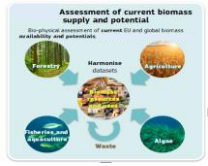




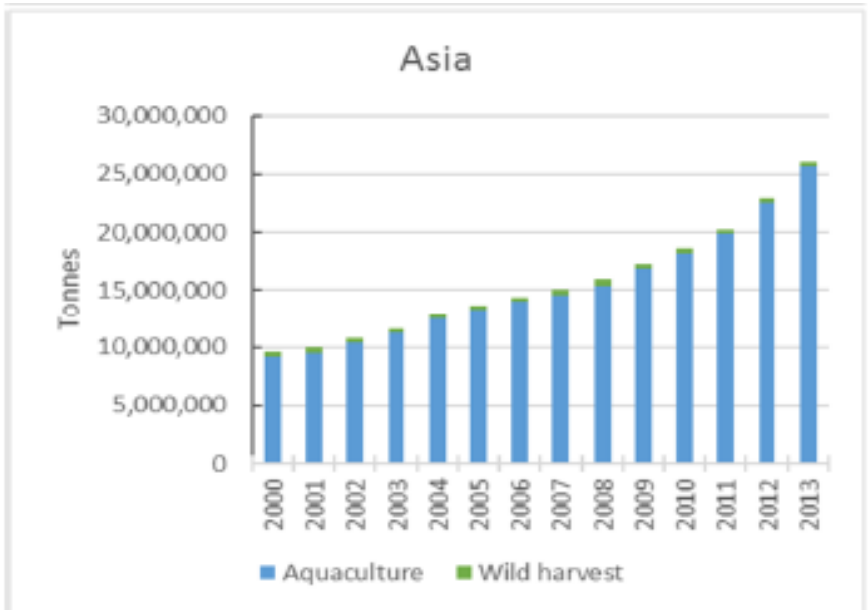
(EU, US, Africa~1%)

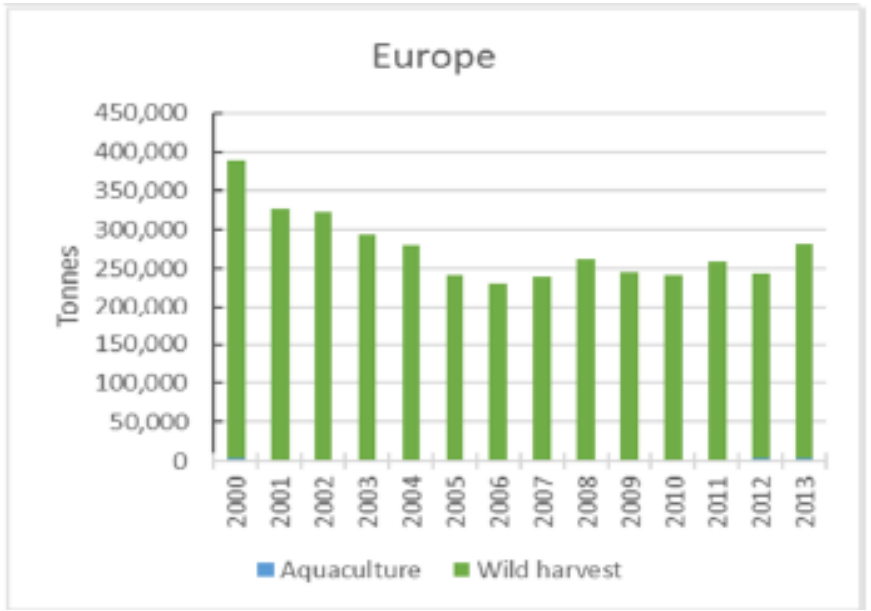
Source: Jung, Bioresource Technology (2013)

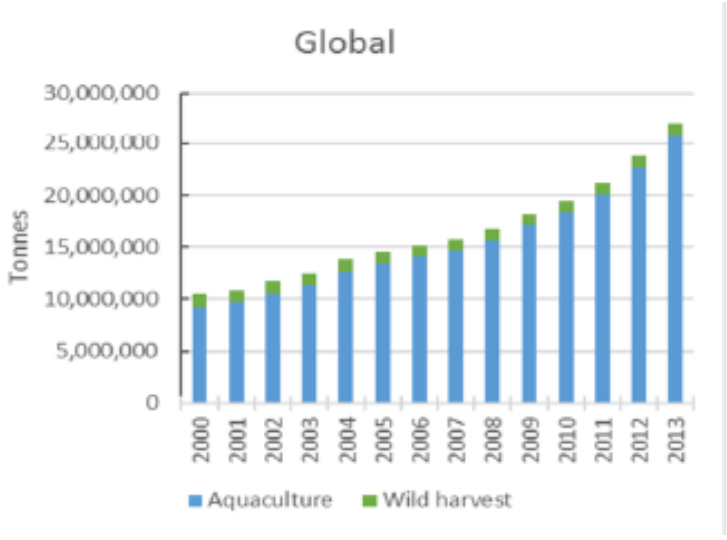
Seaweed production
80% is related to human consumption
Food or flavouring compounds

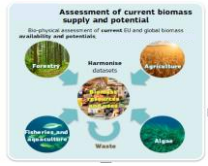


Seaweed biomass Harvest/Aquaculture









ILVO
Instituut voor Landbouw- en Visserijonderzoek

MarineBiotech

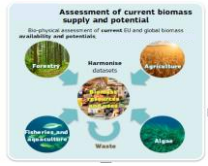
Seaweed in EU- SWOT

Need for higher production

Valorisation potential for seaweed

- Food
  High potential – food security
  Need for higher production to become commodity from (now) artisanal product

  Interest from foodprocessors and foodmakers to bring product to broader makrter



- Biorefinery Seaweed
  Carbohydrate difference versus terrestrial biomass
  Other refinery

ILVO
Instituut voor Landbouw- en Visserijonderzoek

Seaweed in EU- SWOT

Need for higher production

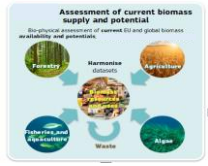
Harvest versus Cultivation

Harvested biomass

Sustainability (scoring- Quota, harvesting schemes)

Varying quality and safety

- Quality
- Seasonality and supply
- FoodSafety
  - Litter and microplastics (storm)
  - Chemicals
- ….



Seaweed in EU- SWOT

Need for higher production

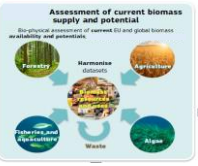
More Biomass is needed- what is the opportunity for Europe

Import from Asia versus EU

FoodQuality aspects

- No traceability
- Food Quality- Food norms
- Palatability ‘taste features’
- Fresh- Transport issue

- **‘European’ biomass**



‘European Seaweed’

With European quality and European taste sustainably grown and cultivated

The way forward

Science

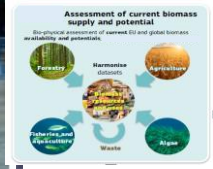
- ‘European taste’ seaweed
- Constant supply and quality

Technology

- New harvesting- long lines, textiles…
- Upscaling to pilot and industrial scale

Policy

- to di-risk upscaling
- Several initiatives are running by different (regional) authorities (Flanders, Netherlands, Norway, Sweden, Denmark, France…)
- Knowledge is spread so important to collaborate (overseas?!)
- Novel food regulation is a (too) high hurdle- hinders new species (15 May 1997)- ‘grey zone’
- Legal and spatial planning



MarineBiotech

ILVO
Instituut voor Landbouw- en Visserijonderzoek

Biomass processing of seaweed- Biorefinery

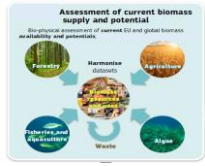
Seaweed products how to further process

‘primary processing steps- how to keep your biomass’- preservation

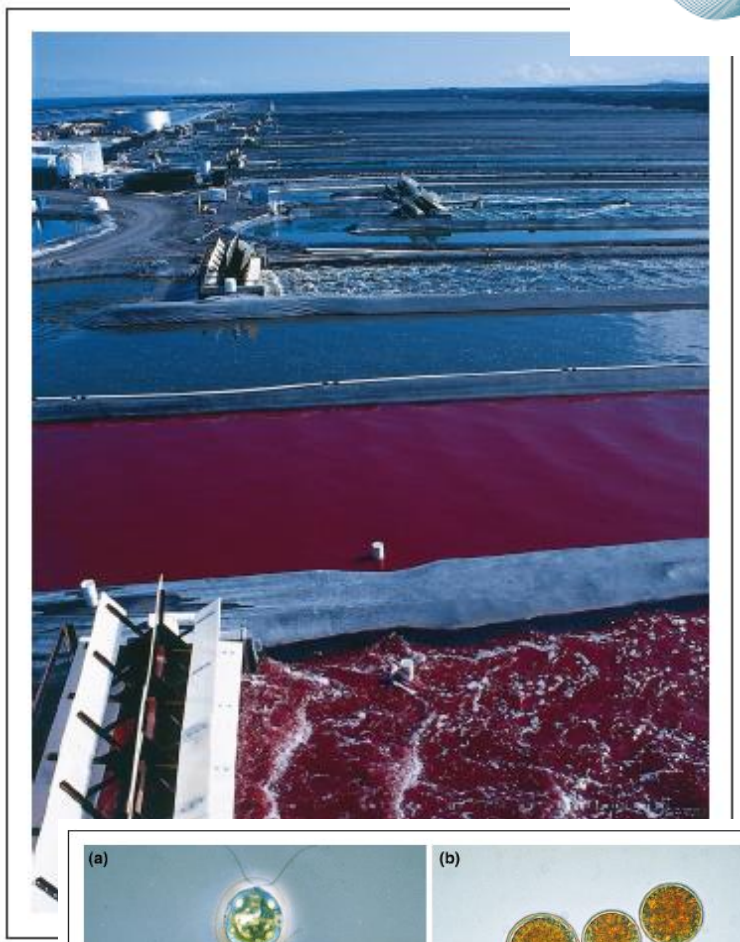
Dyes and hydrocolloids with application in different sectors
‘Cascading’ in zero-waste

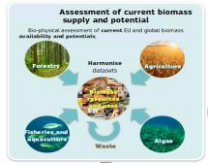
- Chemicals
- Bio-actives: cosmeceuticals, nutraceuticals
- Bio-energy

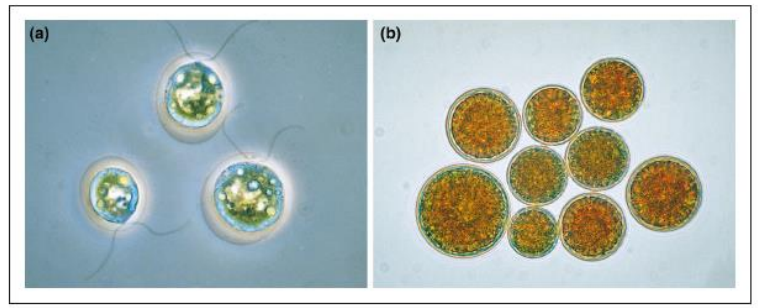
Similar issue as for Microalgae



Biomass processing Microalgae







Main use- Biorefineries

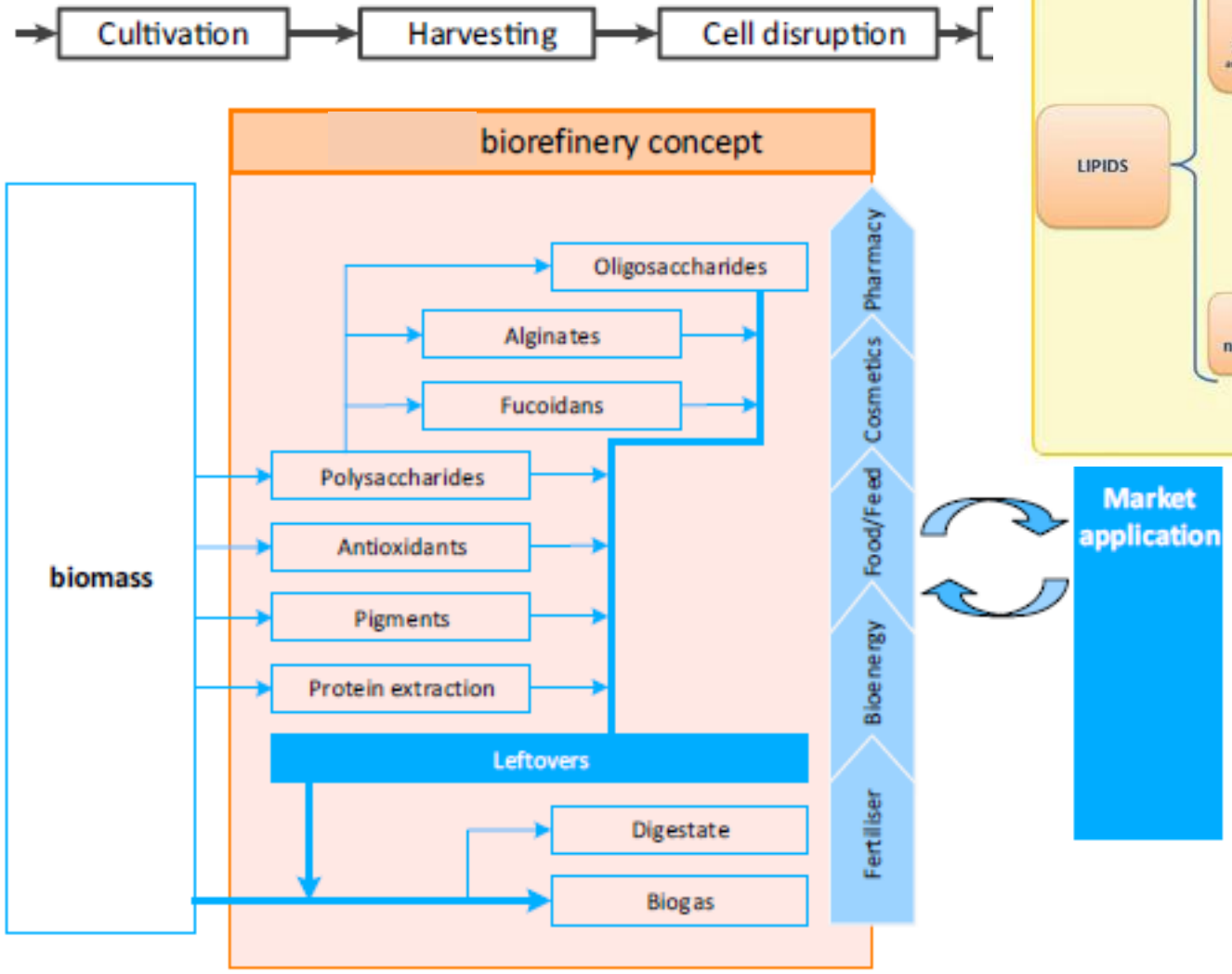
From cultivation to product

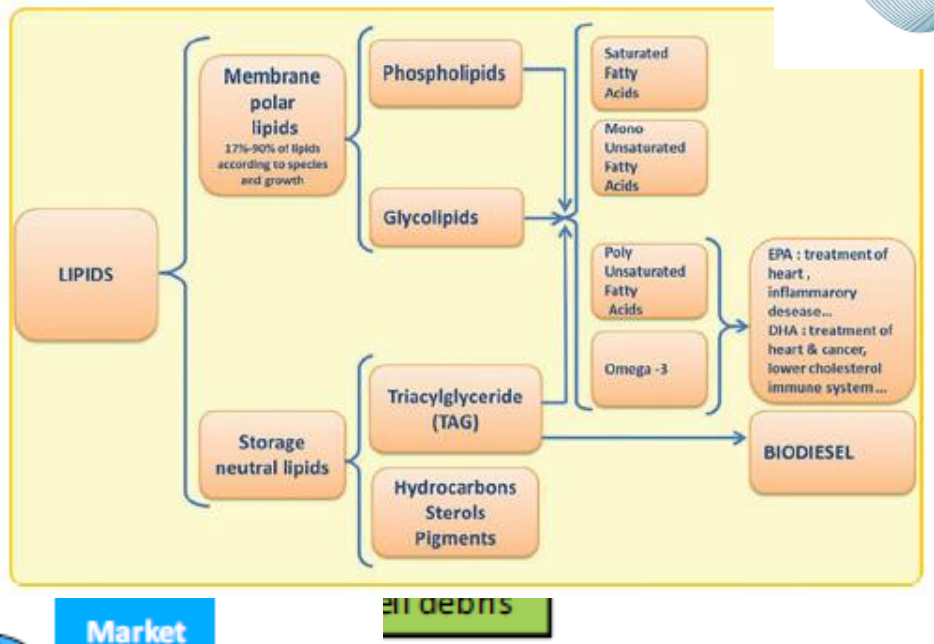
- *Spirulina*- pigment
- *Haematococcus* -asthaxanthin

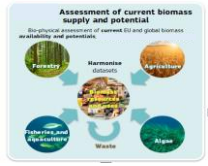
1 component extraction
Rest fraction (bulk or other component) is not or undervalued

Multi-product biorefinery
‘Cascading of extraction with multiple compound with zero-waste?’

Multi-product biorefinery







Source: Balina, 2017

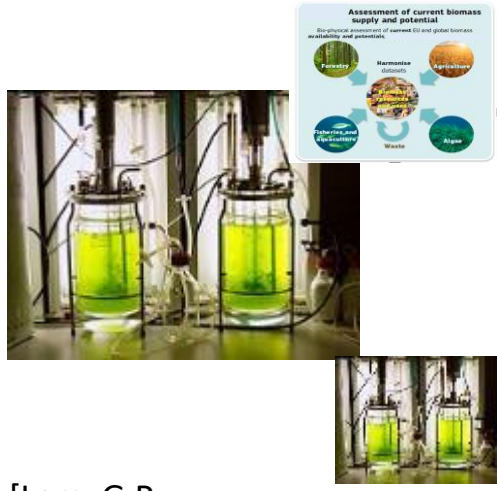
Multi-product biorefinery of microalgae biomass- The Way Forward!

At this moment not realistic

Can we use one general approach for everything?

Science, Technology and Economy- developments should go hand in hand

Economy/Policy
Price of fishmeal 1.36€/kg
Microalgal biomass 20€/kg
(imported from China 5€/kg)



[Lam, G.P.
Trends in Biotechnology (2017)]

Science

- GMO, Metabolic engineering
- Cell membrane **insight within cell wall for efficient disruption?**
- *Scientific development with upscaling as a prerequisite*

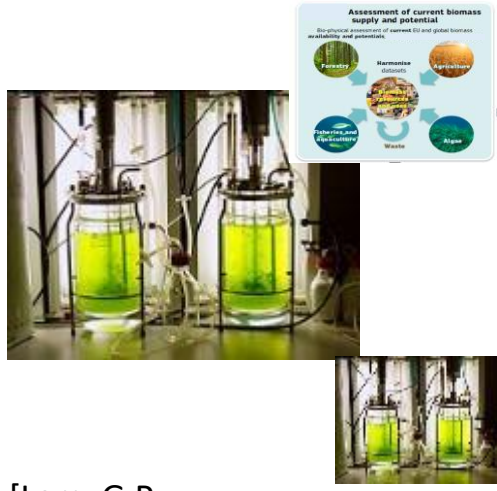
Multi-product biorefinery of microalgae biomass- The Way Forward
So far not realistic, Can we use one general approach for everything?
Science, Technology and Economy- developments should go hand in hand

Technology

- Cell harvesting
- 'primary processing steps- how to keep your biomass'- **preservation**
- Cell disruption: cell wall composition removal under mild conditions versus mechanical disruption
- Extraction: extraction of lipids with organic solvents versus denaturing of proteins

…

Sequential extraction steps in multi-product biorefinery versus simplified extraction in bi-product biorefinery

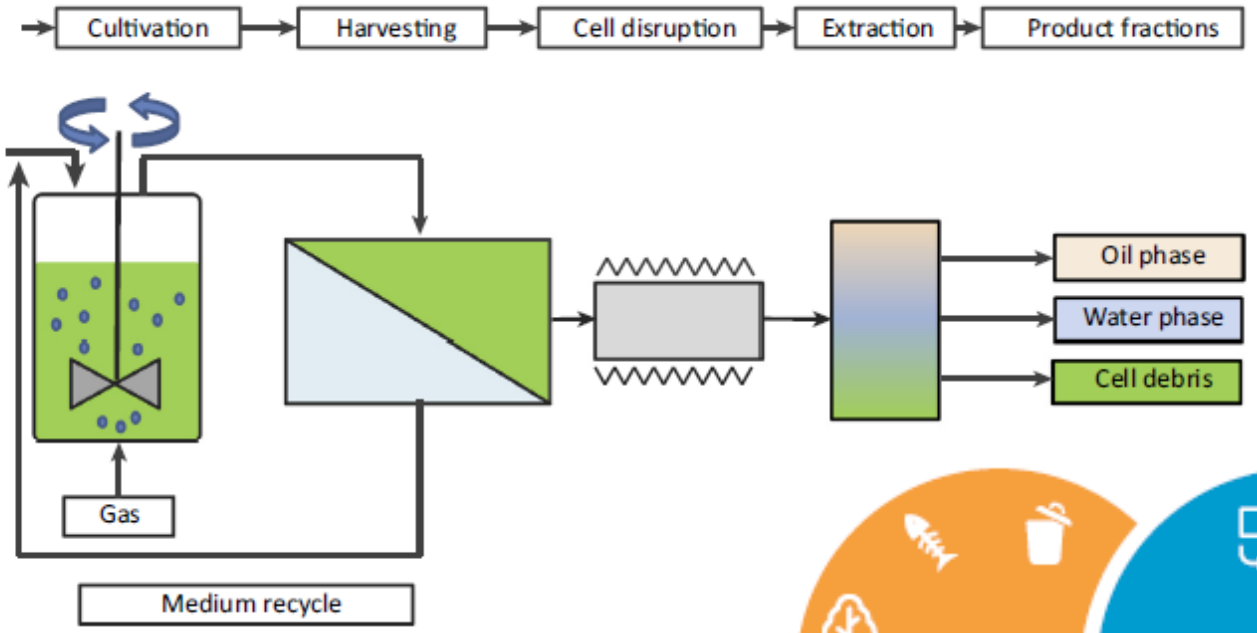


[Lam, G.P.
Trends in Biotechnology (2017)]

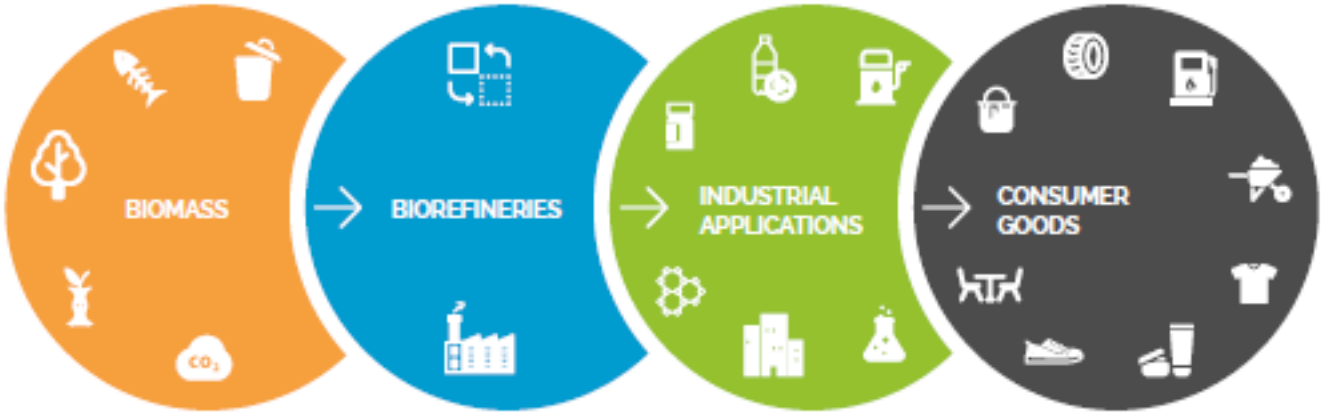
Multi-product biorefinery of microalgae biomass- The Way Forward

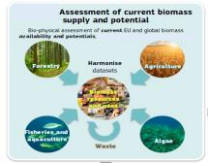
**** Sequential extraction steps in multi-product biorefinery versus simplified extraction in bi-product biorefinery***

*** Include complete value chain**



[Lam, G.P.
Trends in Biotechnology (2017)]





BioMass Value Chain- **include the complete value chain** from on step 1
'You are never better than your first step'

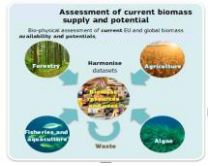
MarineBiotech

Economy/Policy

Upscaling

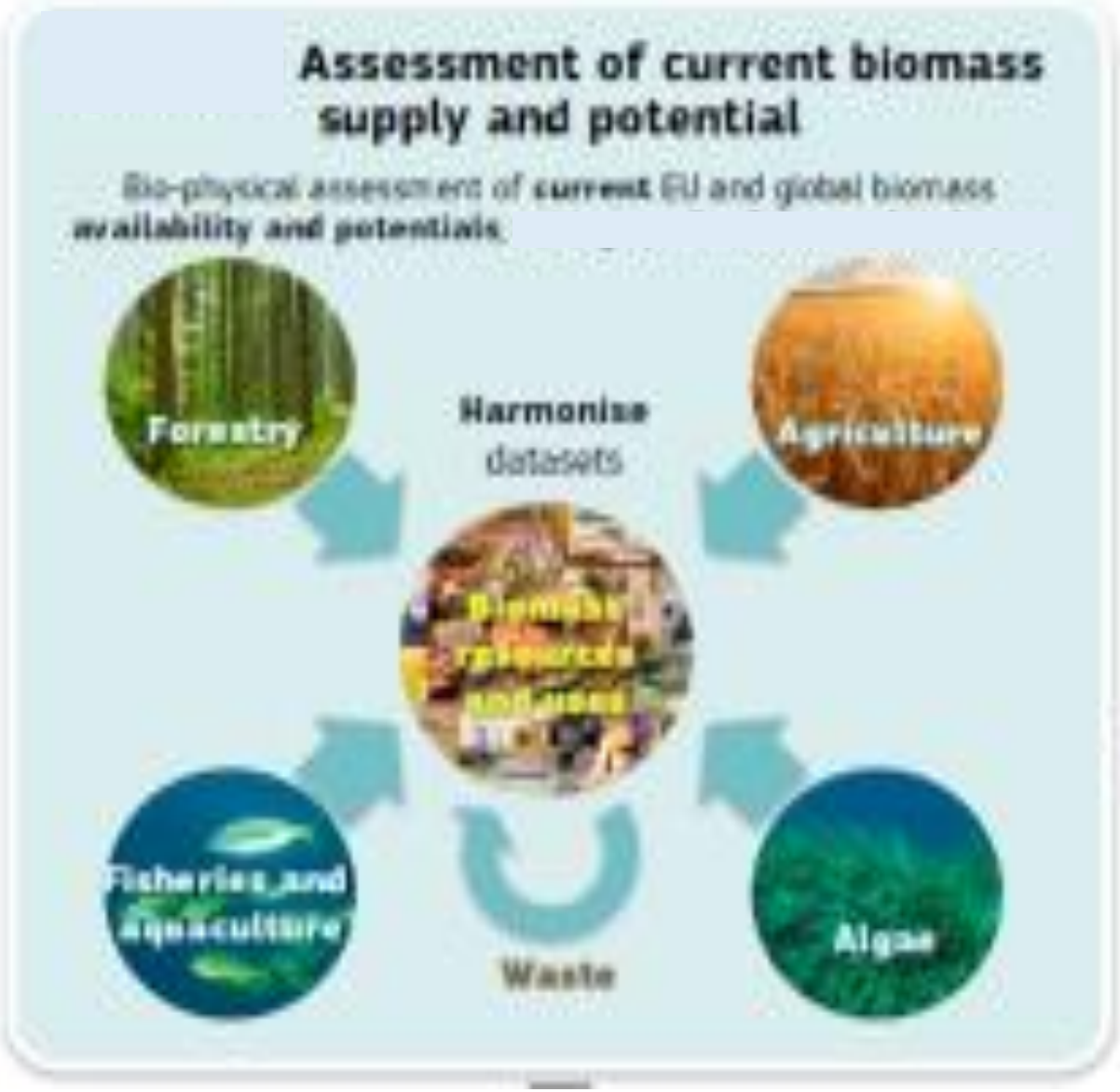
Several technologies are ready to exit lab and be explored in scale-up phase

economic risk is too high and ‘valley of death’… lack of funding to move from proof of concept to product



Need for ‘di-risking’

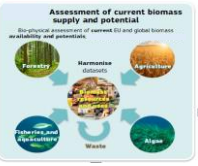
ILVO
Instituut voor Landbouw- en Visserijonderzoek



Source: JRC BioMass Assessment Study

Marine Biomass

- **Algae**
- **Fisheries**



Eranet Roadmap Marine Biotech
'Marine Biomass relevant for Marine Biotech'

- **Aquaculture products – Algae**
- **Fisheries**
- **Marine Micro-organism**
- **Marine Invertebrates**

Food Research International 56 (2014) 115–125

Contents lists available at ScienceDirect

Food Research International

journal homepage: www.elsevier.com/locate/foodres

Review

Marine microorganisms: An emerging avenue in modern nutraceuticals and functional foods

Pradeep Dewapriya [a], Se-kwon Kim [a,b,*]

[a] Marine Biochemistry Laboratory, Department of Chemistry, Pukyong National University, Busan 608-737, Republic of Korea
[b] Marine Bio-process Research Center, Pukyong National University, Busan 608-737, Republic of Korea

Marine Environmental Research 128 (2017) 58–69

Contents lists available at ScienceDirect

Marine Environmental Research

journal homepage: www.elsevier.com/locate/marenvrev

Marine microorganisms as a promising and sustainable source of bioactive molecules

G. Romano [a,*], M. Costantini [b], C. Sansone [a], C. Lauritano [a], N. Ruocco [b,c,d], A. Ianora [a]

[a] Department of Integrative Marine Ecology, Stazione Zoologica Anton Dohrn, Villa Comunale, 80121 Napoli, Italy
[b] Department of Biology and Evolution of Marine Organisms, Stazione Zoologica Anton Dohrn, Villa Comunale, 80121 Napoli, Italy
[c] Department of Biology, University of Naples Federico II, Complesso Universitario di Monte Sant'Angelo, Via Cinthia, 80126 Napoli, Italy
[d] Bio-Organic Chemistry Unit, Institute of Biomolecular Chemistry-CNR, Via Campi Flegrei 34, Pozzuoli, Naples 80078, Italy

MarineBiotech

Potential application of marine microorganisms in health products

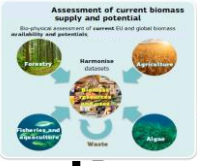
ILVO
Instituut voor Landbouw- en Visserijonderzoek

Potential application of invertebrates

MarineBiotech

LC-BG-03-2018: Sustainable harvesting of marine biological resources

Specific Challenge: In the search for new biological resources, a large unexploited biomas has been identified in the mesopelagic zone (water column between 200 and 1000 m). This largely unknown zone includes micro-organisms, copepods, krill and plankton feeding fish that are lower in the food chain, as well as squids and other higher trophic level fish. Thi zone is known to play a significant role in the global carbon cycle, where the concentration o atmospheric carbon dioxide would be ~50% higher without its activities. If exploited at sustainable levels, without impacting upon biodiversity and compromising the oceans' role in climate regulation, this biomass could be used to produce more high quality ingredients (proteins with high nutritional value and polyunsaturated fatty acids) for human food chain (which includes farmed animals), to decrease the fishing pressure on overexploited species of



RIA- Research and Innovation Action

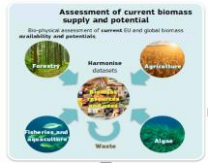
ILVO
Instituut voor Landbouw- en Visserijonderzoek

MarineBiotech

Thank you for your attention!

Questions?

Johan.Robbens@ilvo.vlaanderen.be



Vlaanderen
is landbouw & visserij

Institute for Agricultural and Fisheries Research
Ankerstraat 1
8400 Oostende – Belgium
T + 32 (0)59 98 50

Johan.Robbens@ilvo.vlaanderen.be
www.ilvo.vlaanderen.be