Application Centre for Renewable Resources
ACRRES
een Wageningen UR initiatief

Recycling nutrients and valorise side streams in local biorefineries

11 th conference Renewable Resources and biorefineries 3-5 june York

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PROVINCIE FLEVOLAND

Europees Landbouwfonds voor Plattelandsontwikkeling:
Europa investeert in zijn platteland

ACRRES: Application Centre for Renewable RESources

Part of Wageningen University where we:

- experiment with, test and demonstrate ….
- sustainably energy solutions based on sun, wind or biomass and applications of green raw materials for chemicals, building materials and others ……..
- at pilot/ semi practice scale.....
- in co-operation with companies, NGO's and governments

EnAlgae
collaborate innovate communicate

Investing in Opportunities
This project has received European Regional Development Funding through INTERREG IV B.
nwe
INTERREG IVB

INEMAD

PUFA Chain

GROW 2 BUILD

Content

- Motivation and goal
- Two examples
- Challenges
- Conclusion

FAO report 2009

- World population in 2050: 9.1 billion people
- Increased income levels
- Need to increase food production by 70%
  - ❑Meat production: 229 → 465 Mtonnes
  - ❑Milk production: 580 → 1043 Mtonnes

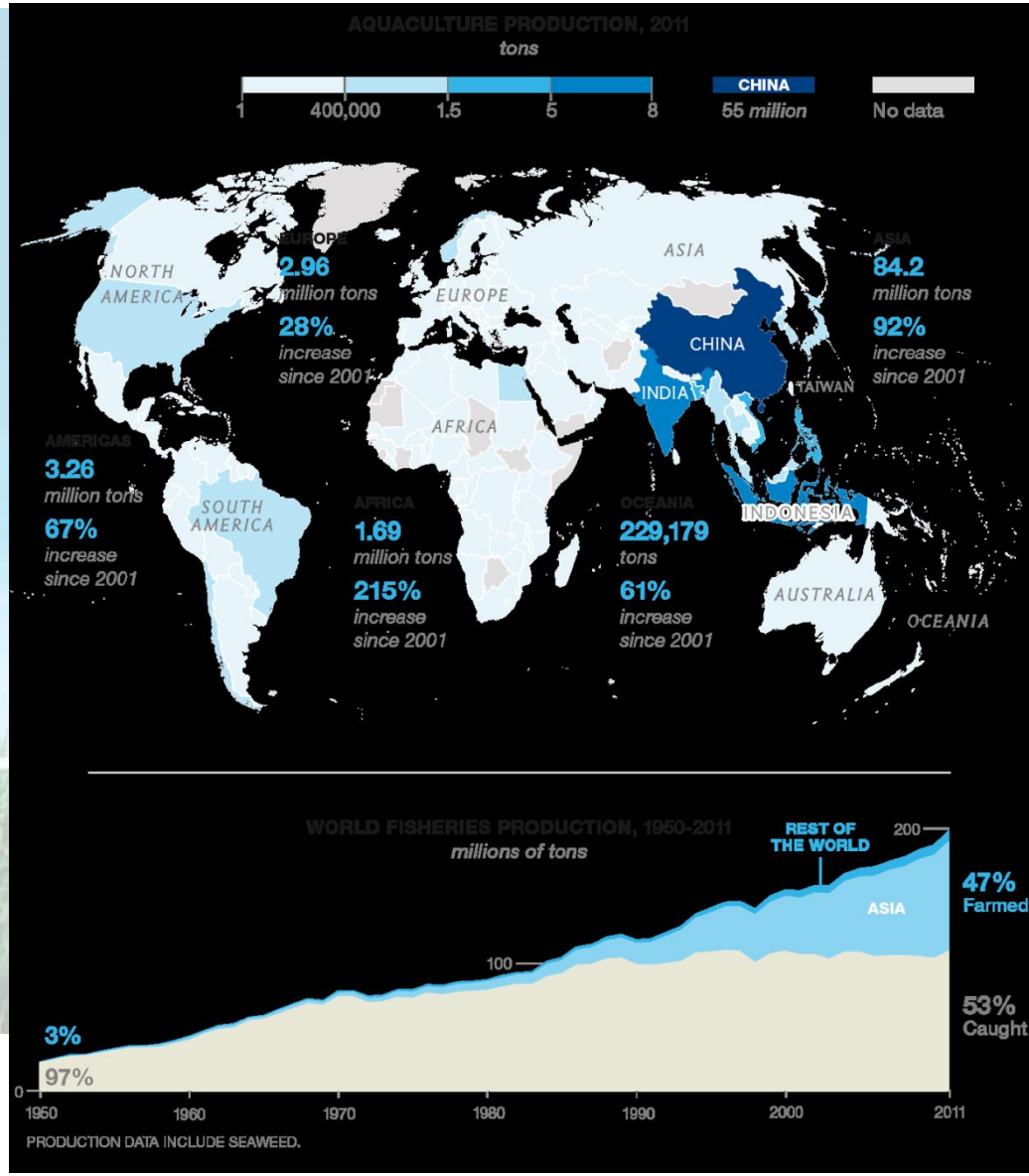
Max production but more people

Fish catch:

- Catch at max 1990
- More -> fish-farming

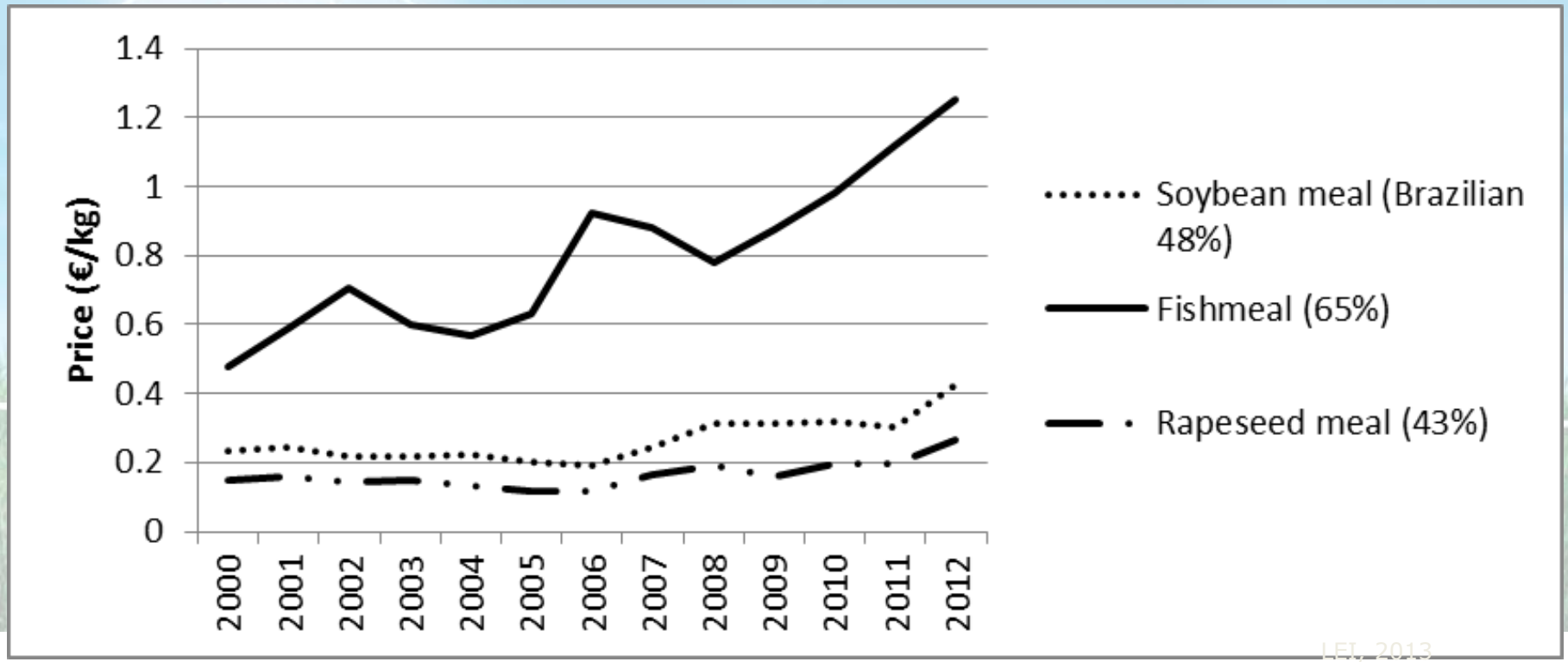
Commodities:

- 70% surface in use
- Shortage sweet water
- Short P on term
- Increase CO2 level



Scarcity of protein sources for feed: European price development

- *Price soybean meal: from 2000 – 2012 doubled*
- *Price fishmeal: from 2000 – 2012 tripled*



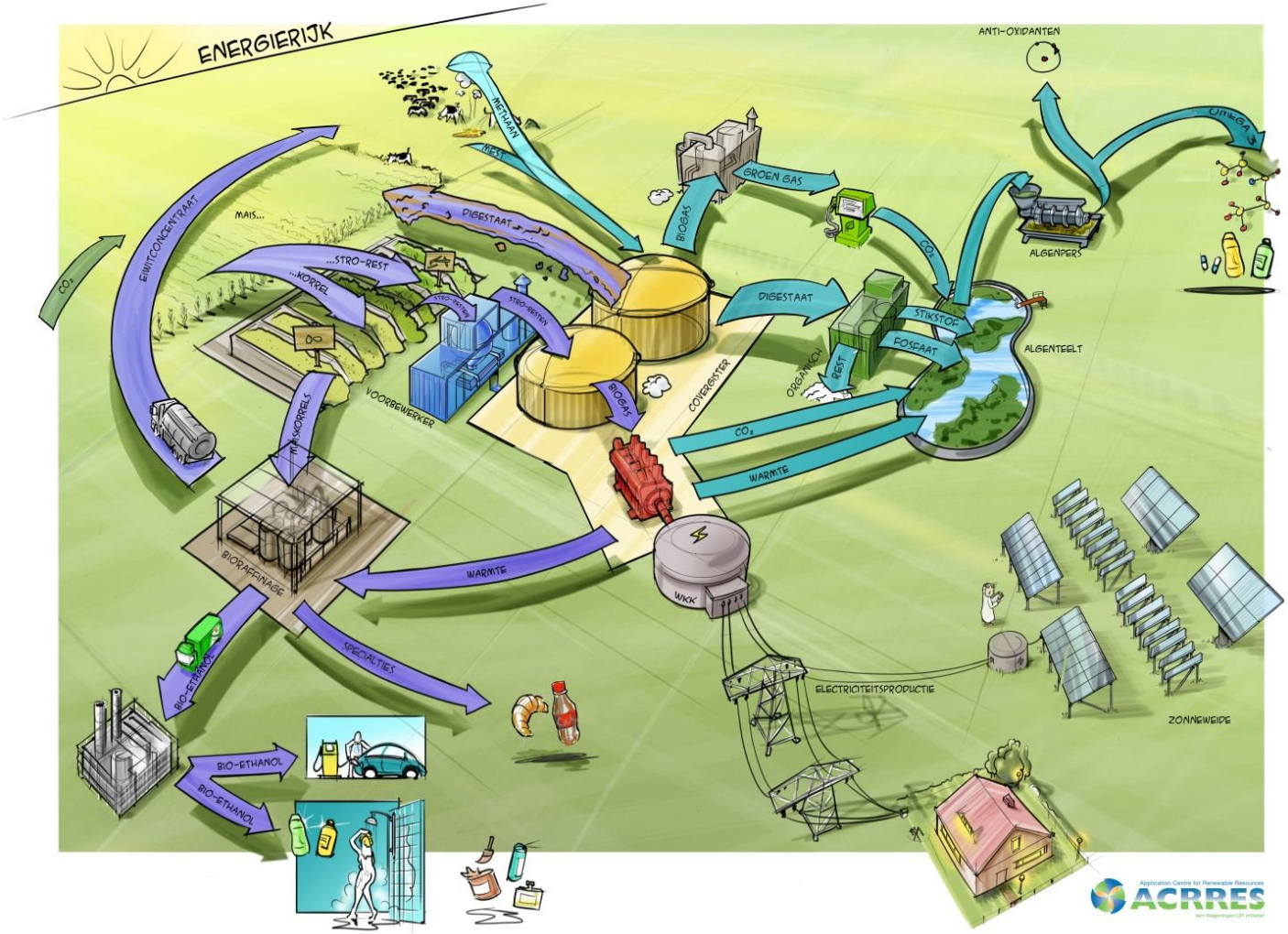
Need for new proteins

- Limited amount of fallow hectares
- Increasing crop yield can contribute
- Closing nutrient cycles to prevent waste
- High yield/ha proteins
  - ❑ Algae
  - ❑ Water plants
  - ❑ Insects

Goal

- Maximizing the valorisation of locally produced biomass or side streams for food/feed, chemicals or energy
- Transport high value products, minimise transport of ‘water’
- Maximised local re-use of nutrients and side streams

Example: ACRRES



ACRRES site Lelystad

Pilots at ACRRES in Lelystad digester –algae,..





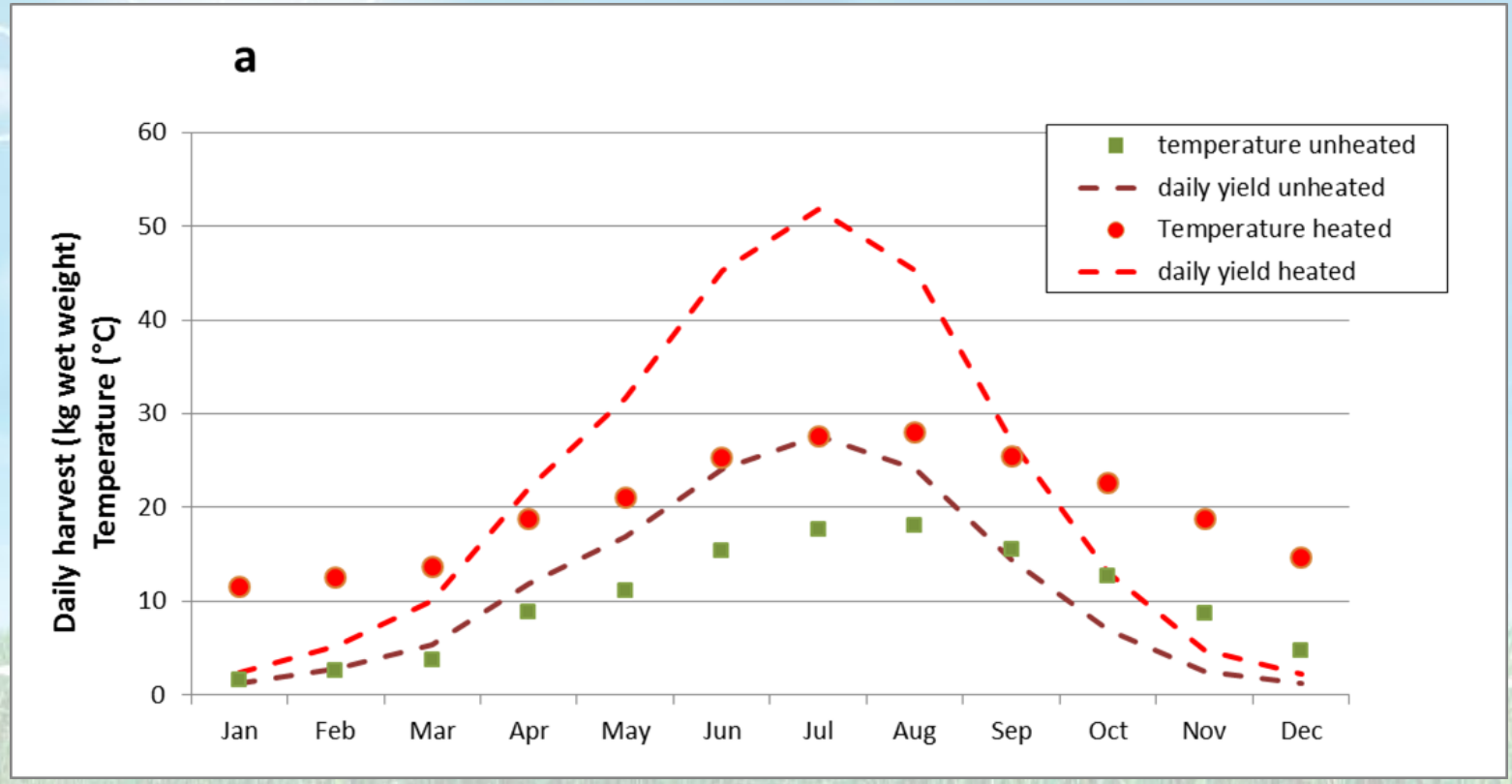

Sustainable algae growth

- Water
- Nutrients (N/P)

} aqueous waste streams

- CO_2 } re-use of flue gas
- Heat } use of residual heath
- Light } natural available or LED
- Harvesting system

Effect of residual heath (CHP) on algae growth



Value of algae (review/ selling price)

- 35 euro/kg dry algae (additive for feed)
- Increasing evidence health effects (Becker, 2013, Lum, 2013 a.o.): lower mortality rate, lower microbial infections; increased milk production and increased feed conversion efficiency; value-added animal products for humans -> but more proofs/research needed
- Great potential for protein production per ha compared to arable crops (4-10X increase) but not yet at comparable cost price
- Recycling of nutrients in aqueous effluent ao

Legislation

Before 2013 growing on manure of digestate

-> not allowed to sell as feed for GMP+

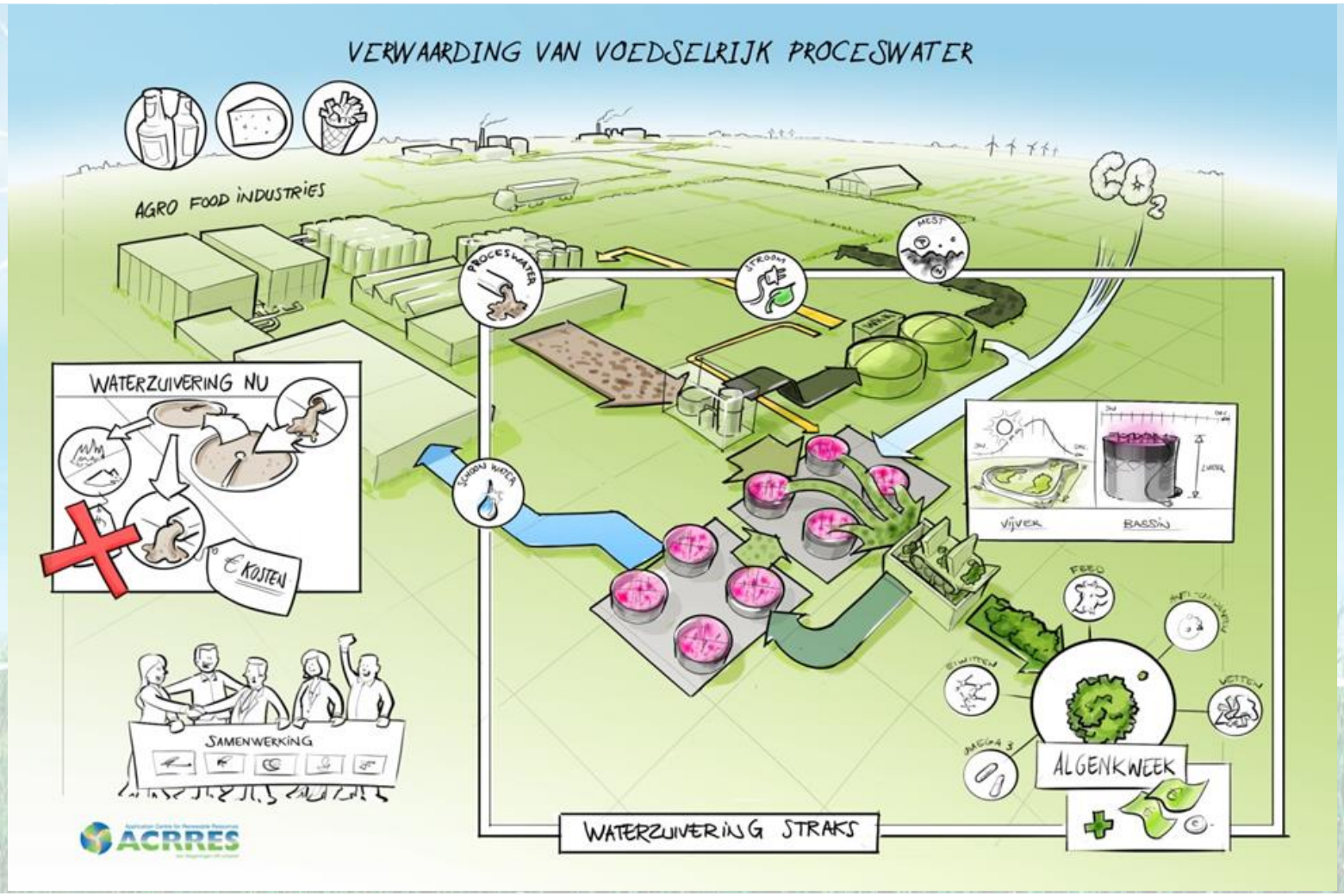
Changed in:

-> risk analyses conducted on production method and additional analyses

Economics

- Cost price (1 ha scale, Nl, 17 t/ha): 6 euro kg
- Main components (capital, labour, power)
- Return on investment 20-25% in combination with digester and <0% without digester (ACRRES scale)

Example: effluent polishing process water



Pilot at brewery

Results site 2013

	M3reactor			2 L chemostaat	
	COD (mg/l)	N (mg/l)	P (mg/l)	N (mg/l)	P (mg/l)
Result algae effluent polishing	120-150	8-10	4-5	3-4	1-2
	(60-70%)	(70-80 %)	(30-40 %)	(80-90)	(80-90%)
Result aerobic water treatment	48	9.5	4		

Effluent polishing with algae possible

Economics need to be improved for this process water

Influent en effluent pretreatment

Pretreatment brewery effluent

Photobioreactors

Stock culture mix of Chorella sorokiniana and Scenedesmus obliquus

LED light in photobioreactors

Challenges local biorefineries

Outside agriculture and less ground usage:

- Traditional agricultural crops 1,000-2,000 kg protein/ha
- Algae 4,000-15,000 kg protein/ha

Reuse residues:

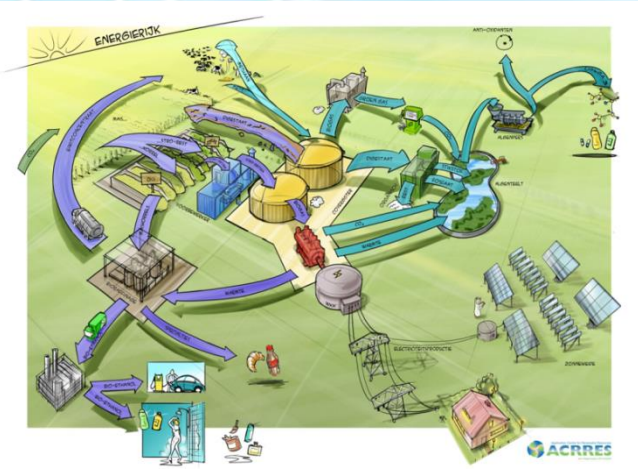
- Nutrients and hydrocarbon in watery effluent
- Heat and CO2 (flue gas)

Less energy and greenhouse gas?

Local (phosphate) cycle

Additional value for feed/food

Legislation



Conclusions

- It is possible to valorise side streams and recycle part of the nutrients in local biorefineries and producing proteins not competing with agriculture

- There are challenges to address, innovate and improve in cooperation with companies and research

- Local biorefinery can be a stepping stone in development and implementation of the biobased economy and as new possibility in a circular economy

More info

www.acrres.nl

www.enalgae.eu

Further collaboration

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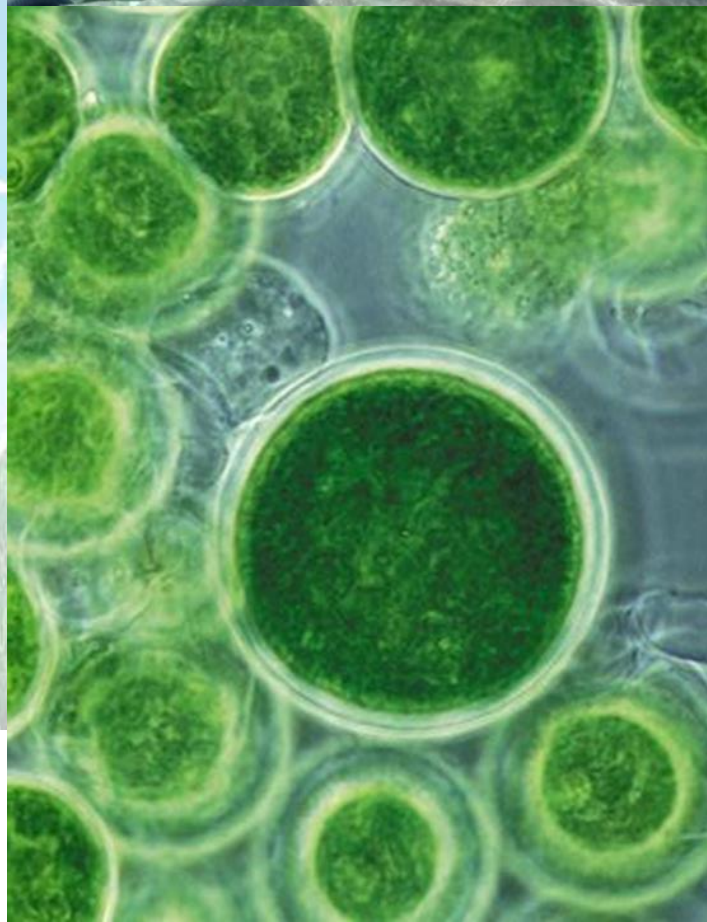

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Thanks for your attention

And discussion!

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