Dutch Wastewater management

A contribution to the circular economy

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DUTCH WATER AUTHORITIES

Hoogheemraadschap van Rijnland

Introduction

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Water management in The Netherlands

European Union
Legislation

National level
Legislation, water management, big rivers

Provincial level
Regulations, spatial planning

Municipal level
Town planning, Sewage system

Waterauthorities
Regional Water management,
Waste water treatment

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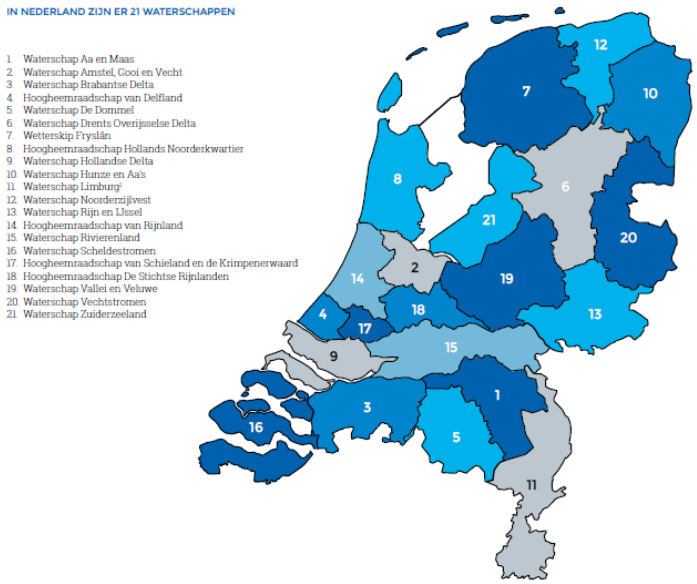
Waterauthorities

Independent government body:

- since 1255
- own legal power
- own tax system
- own elections
- 11.000 employees
- Amount of wwtp; 335
- Taxes income; € 2700 mln (2017)



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National level ambition; sustainable economical growth

- Ambition: economy is growing in size, without disadvantages for climate , water, soil , raw materials and biodiversity
- Society develops sustainable plans and takes initiatives
- National sustainable development policy

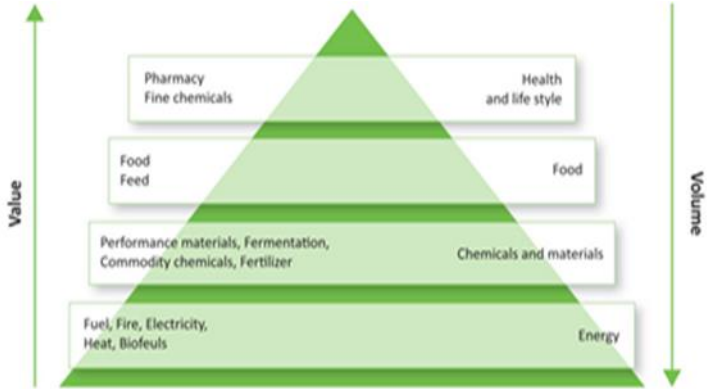
  circular economy
  - 50% less use of primary raw materials in 2030
  - circular economy in 2050

  energy agreement
  - 1,5% a year savings in energy consumption
  - increase renewable energy: 4% 2013 to 14% in 2020

Ambition regional water authorities

Circular Economy

- Recovery of materials from waste water
- Buying sustainable products (green energy)



Energy agreement

- 2% a year savings in energy consumption
- increase renewable energy: 30% 2016 to 40% in 2020

Instruments for sustainable development

1. WWTP as energy and raw materials factory

2. Regional water authorities as launching customers

3. Administrative agreements

Instrument 1: Energy and raw materials factory

Collaborative network organization

- Dutch water authorities,
- the Foundation for Applied Water Research (STOWA),
- knowledge institutes (Delft University, WETSUS, Wageningen University),
- The Netherlands Green Gas Foundation,
- Aqua minerals,
- and many others.

Products

- Phosphate,
- Cellulose,
- Bioplastics
- Alginate
- Proteins?
- Energy

"wastewater is a valuable source of renewable energy, raw materials, and clean water"

http://www.efgf.nl/
https://www.youtube.com/watch?v=CT9lVE6wfIc

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Instrument 2: Regional water authorities as launching customers

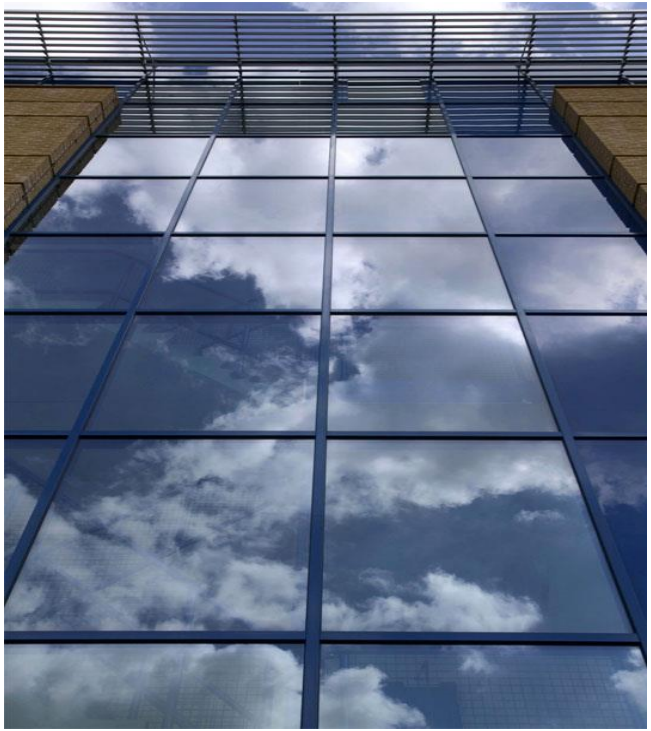
1. user of principle innovations that are applicable elswhere
2. Making sites and resources available for companies and research institutions
3. Procure in an innovative manner

Instrument 3: administrative agreements

1. green deal raw materials 2014
2. green deal energy 2016
3. regional agreement water chain 2016

“Green Deal” approach

- To implement sustainable initiatives from companies and society
- Scaling-up of initiatives, combine experiences, to come to a broader application
- Themes; energy , water, transportation , climate, biodiversity, bio-based economy , raw materials , food and construction
- Government helps against (legal) barriers



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What is accomplished so far?

Energy-production

- Legal aspects examined for the supply of electricity, gas and heat.
- Research on balance between raw material recovery and energy efficiency
- Explore local markets; supply & demand

waterschaps energie

Dat maken we samen!

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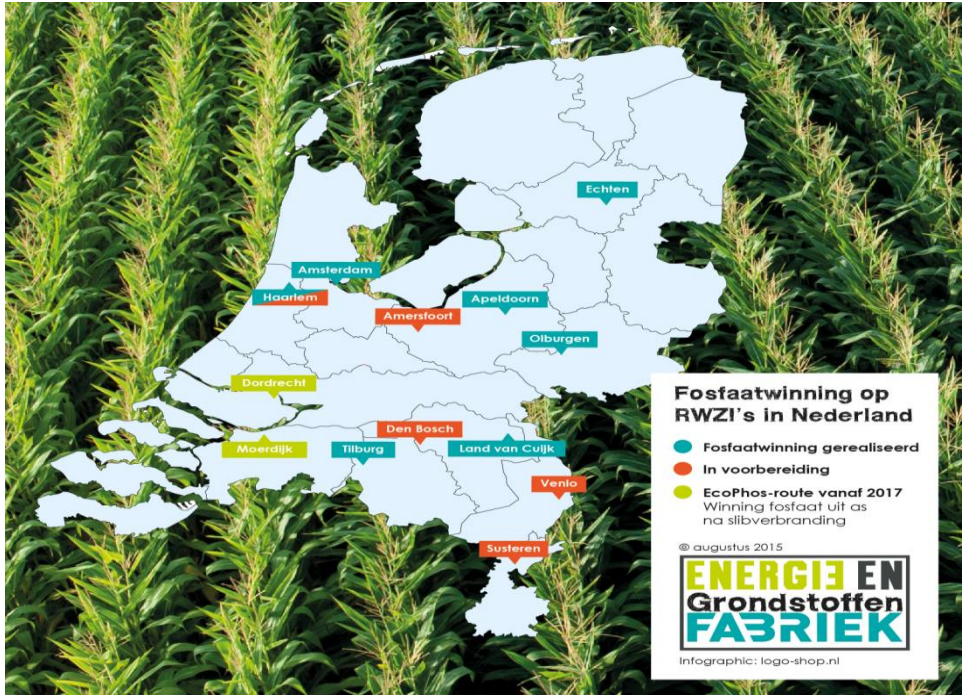
Phosphorus



Phosphorus recovery as a fertilizer

- Research on struvite recovery
- Research on fertilizer value
- Quality control of produced struvite.
- Legislation; Struvite is listed as recovered fertilizer in an implementation-directive
- construction of ecophos-plant (Dunkirk) to recover phoshphorus from sludgeincineration-ash

Cellulose

Research revenue model and (local) markets;

- insulating material in construction
- bio-ethanol production;
- "run-off" inhibitor in asphalt

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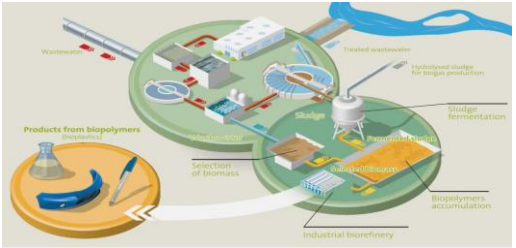
Bioplastics (PHA)



Research on technical/economic feasibility;

- The harvested activated sludge can consistently produce a high quality PHA polymer that has interesting and meaningful application potentials.
- PHA can be produced at a competitive cost prize.
- The produced polymer has a 70% lower environmental impact compared to currently available PHA bioplastic.

Next step; upscaling to the demonstration phase and building a commercial factory to produce around 5,000 tons of PHBV per year with the potential to further scale up later on.

https://www.stowa.nl/sites/default/files/assets/PUBLICATIES/Publicaties%202017/STOWA%202017-15.pdf

Neo-alginate

Research finished on;

- quality and quantity of alginate production from WWTP (nereda-technology)
- revenue model and (local) potential markets including application tests
- Extraction technology

Construction of a production facility in Zutphen started december 2017

Power-to-protein concept

Biochemical conversion with carbon capture and ammonia recovery

power to PROTEIN

https://www.powertoprotein.eu/

"*Can direct conversion of used nitrogen to new feed and protein help feed the world?*"

Ammonia from the waste water

Hydrogen Oxidizing Bacteria (HOB):

Aerobic, facultative autotrophic bacteria
By means of H_2 oxidation, CO_2 and NH_3-N
are incorporated into **protein-rich biomass: SCP**

$$5.2\ \mathbf{H_2} + 1.5\ O_2 + 1.0\ \mathbf{CO_2} + 0.2\ \mathbf{NH_3} \rightarrow \mathbf{CH_{1.7}O_{0.5}N_{0.2}} + 4.6\ H_2O$$

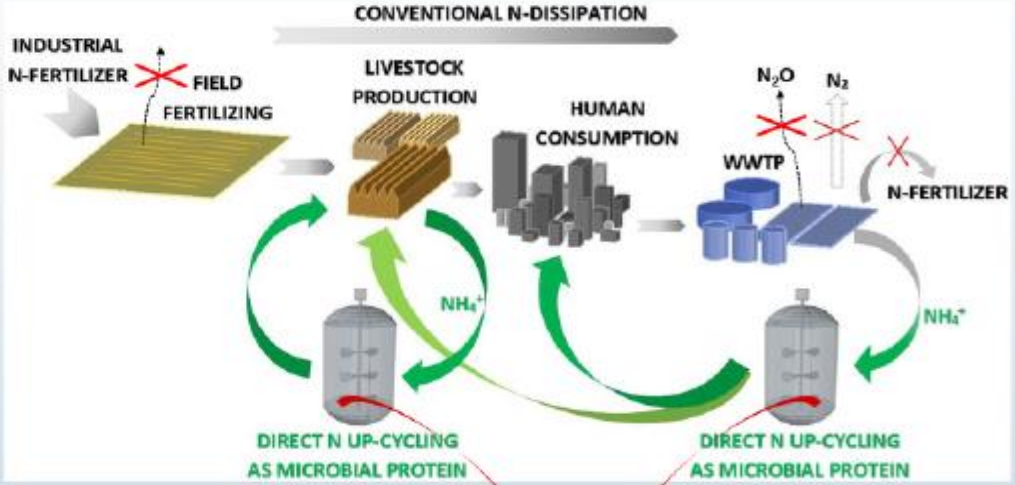
Power-to-protein concept

Direct upcycling of ammonia as microbial protein

The man-made artificial nitrogen cycle is very inefficient

Haber Bosch → reactive N:
145 million tons/year enter our biosphere

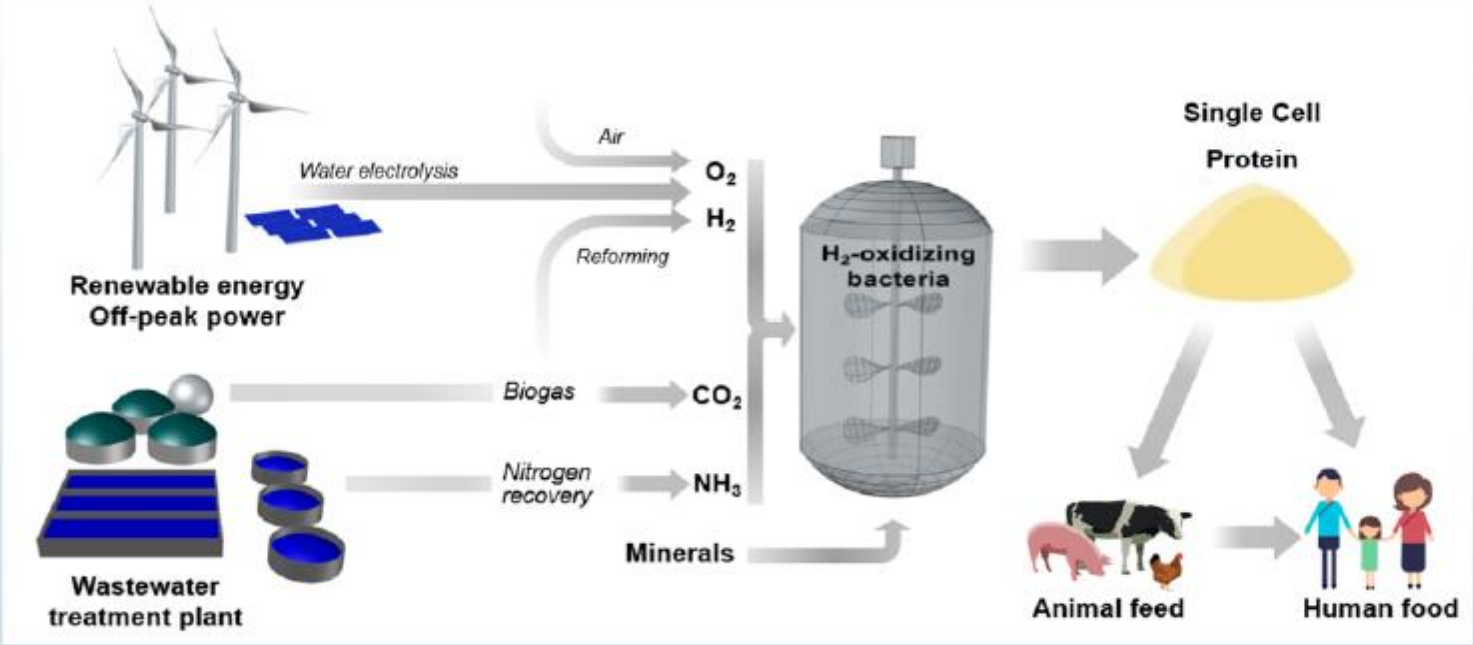
Only 16% becomes edible protein; 84 % is lost to the environment



SOURCE: MATASSA, S. ET AL., ENVIRON. SCI. TECHNOL., 49 (2015), 5247 - 5254

Power-to-protein concept

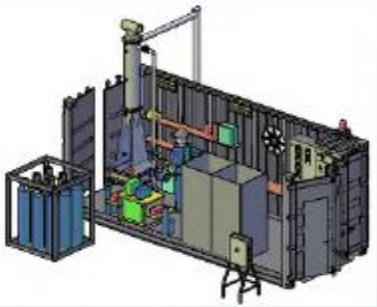
All sources from the waste water chain



Power-to-protein project

Under the TKI Water Technology Programme

KWR Watercycle Research Institute
Avecom
aeb amsterdam
BARENTZ
waternet
Waterkracht



Early 2016
Desk study

Late 2016
Pilot plant design and building

2017
Pilot test start on site of WWTP

Questions?


Eat
Grow
Discard
Broken
Chemical Fertilizer
Waste & Pollution
Eat
Intact
Grow
Excrete
COMPOST
Return to Soil

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