ARREAU

1st meeting at IWA WWC Lisbon,
23 September 2014

Henry van Veldhuizen, Marthe de Graaff,
Theo van den Hoven
Tuesday 23 September, 17:00u-19:00u. Location: room 0.06, Lisbon. Agenda:

- 17:00u Welcome and short introduction by Theo van den Hoven/Marthe de Graaff
- 17:15u: Update ARREAU: progress made until now, updates from working groups
- 17:45u: Involvement of members: Each member will get the opportunity to present their organization. Please address your motivation to be part of ARREAU, interests and projects related to resource recovery and acceleration to market application. If you want you can show one or two slides.
- 18:45u Wrap up and closure
European Innovation Partnership on Water
New EC instrument to boost innovation

- Launched in May 2012 to
  - Facilitate, support and speed up development and application/deployment of innovative solutions to water challenges
  - Create market opportunities for innovations

- High level governance and visibility

- Strategic Implementation Plan
EIP-Water

Cross-cutting issues
Water governance
Decision support systems and monitoring
Financing for innovation

Water-reuse and recycling
Water and waste water treatment, including recovery of resources
Water-energy nexus
Flood and drought risk management
Ecosystem services

Smart technology

Vision and objectives
H2020 to finance the EIP-Water

**SOCIETAL CHALLENGES 31.0 billion €**
- Health, demographic change and wellbeing
- Food security, **sustainable agriculture**, marine and maritime research and the bioeconomy
- Secure, clean and **efficient energy**
- Smart, green and integrated **transport**
- Climate action, **Resource Efficiency and Raw Materials**
- Inclusive, innovative and secure societies

**INDUSTRIAL LEADERSHIP 17.0 billion €**
- Leadership in enabling and industrial technologies (ICT, nano, materials, bio, manufacturing, space)
- Access to **risk finance**
- Innovation in **SMEs**

**EXCELLENT SCIENCE 24.3 billion €**
- European Research Council
- Future and Emerging Technologies
- Marie Skłodowska Curie actions on skills, training and career development
- Research infrastructures
EIP Water activities

- **Task Force** – work on barriers and policy recommendations

- **EIP Water Tools** – Web based Market Place, Annual Conference etc.

- **Action Groups**
Organisation
Action Groups – Expectations

- Development of innovative solutions involving the entire innovation value chain

- Identification of barriers to innovation through experiences, translated into policy recommendations for their removal

- Support of implementation of water policy
- CITY BLUEPRINTS - Improving Implementation Capacities of Cities and Regions (AG041)
- ARREAU - Accelerating Resource Recovery from Water Cycle (AG108)
- COWAMA - Mitigation of Water Stress in Coastal Zones by Sustainable Water Management (AG111)
- CTRL+SWAN - Cloud Technologies & Real time monitoring + Smart WAter Network (AG126)
- EWW - Energy and Water Works - energizing sustainable deltas (AG115)
- FinnoWater (AG013)
- InduRe - Industrial Water Re-use and Recycling (AG045)
- MEET-ME4WATER - Meeting Microbial Electrochemistry for water (AG110)
- PVAIZEC - Large PV Pumping Systems for zero energy irrigation (AG103)
- Renewable Energy Desalination (025)
- RESEWAM-O - Remote sensing for water management optimization (AG132)
- RTWQM - Real Time Water Quality Monitoring (AG100)
Approved Action Groups 2

- AugMent - Water Monitoring for Decision Support (AG124)
- DISSME - Demand-Driven Innovation Support for SMEs via NNWPsls (AG131)
- EBCF - European Benchmark Cooperation Foundation (AG125)
- ESE - Ecosystem Services for Europe (AG052)
- MAR Solutions - Managed Aquifer Recharge Strategies and Actions (AG128)
- Anaerobic Membrane Bioreactor for Recovery of Energy and Resources (AG036)
- Verdygo - modular & sustainable wastewater treatment (AG...)

- W4EF - Framework for evaluation and reporting of the energy impacts on water (AG029)
- Water Justice (AG117)
- WaterCoRe - Regional governance of water scarcity and drought issues (AG042)
- WaterReg - Water services regulation and governance in Europe (AG102)
- WIRE - Water & Irrigated agriculture Resilient Europe (AG112)
- SPADIS - Smart Prices and Drought Insurance Schemes in Mediterranean Countries (AG014)
Action Group ARREAU
Accelerating Resource Recovery from the water cycle

Application submitted: January 2014
Proposal approved: April 2014

Objectives

• Review and exchange current European best practices
  • Success factors for viable and profitable value chains
  • Recommendations to remove policy, financial and legal barriers

• Jointly develop value chains and markets
Arreau

EIP-Water

Steering group

Cross-cutting issues

Working Groups

Drinking water resources
Phosphorus from wastewater
Cellulose from wastewater
New resources from water
Action Group ARREAU
Accelerating Resource Recovery from the water cycle

Current actions

• Compendium best practices
• Review bottlenecks
• Prepare visibility at EIP-W annual conference (November 2014)
• Logo and communication material developed
• Open for new members with added value
Members ARREAU

- 4 Water and waste water utilities
- 4 Knowledge providers
- 2 Legal supporters
- 1 Innovation supporter
- 15 Technology providers/processors
- 3 End users

Mainly from North-West Europe
Arreau

- Working Groups
  - Drinking water resources
  - Phosphorus from wastewater
  - Cellulose from wastewater
  - New resources from water

- Cross-cutting issues

- Steering group

- EIP-Water
Working group: Cross cutting issues

- Led by IVL: Östen Ekengren, Staffan Filipsson, Magnus Rahmberg
Legislation for the EU – phosphouros

• Lack of specific regulations
  • Related legislation might apply
• Directive 75/442/EEC and 91/156/EEC
  • Article 4: Waste must not harm the environment
• Directive 86/278/EEC
  • Heavy metals in agriculturally used sewage sludge
• Regulation 1774/2002, Chapter III
  • Pathogens in processed manure products
Legislation in member states - phosphorous

- *Dutch Fertilizer Act*
  - Inclusion of precipitated phosphorus recommended
  - Could regulate phosphate content, heavy metals, organics, pathogens and drug residues
- *Swedish report on phosphorus recycling*
  - Increased phosphorus recovery
  - Limits on eight metals and five organics
  - Preventative measures, including hygienic treatment
- *German regulations on sludge in agriculture*
  - No undegradable content (regulations postponed to 2017)
Exemples of limit values – sludge for use in agriculture

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Limit values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cadmium</td>
<td>20 to 40</td>
</tr>
<tr>
<td>Copper</td>
<td>1 000 to 1 750</td>
</tr>
<tr>
<td>Nickel</td>
<td>300 to 400</td>
</tr>
<tr>
<td>Lead</td>
<td>750 to 1 200</td>
</tr>
<tr>
<td>Zinc</td>
<td>2 500 to 4 000</td>
</tr>
<tr>
<td>Mercury</td>
<td>16 to 25</td>
</tr>
<tr>
<td>Chromium (¹)</td>
<td>—</td>
</tr>
</tbody>
</table>

(¹) It is not possible at this stage to fix limit values for chromium. The Council will fix these limit values later on the basis of proposals to be submitted by the Commission within one year following notification of this Directive.
Activities for cross cutting issues

- Identify legal and regulatory barriers that prohibit the use of residuals as resources.
- Conduct *life cycle assessments (LCA)* for the *recovery routes* that will be used for the *development* of market plans to exploit and commercialize opportunities for recovered resources and for the enabling technologies.
- Identify the gaps between the process oriented organizations in the water cycle and the resource supply market.
Activities for cross cutting issues, cont.

• Identify factors that affect public acceptance for direct re-use of wastewater resources.

• Identify success factors for viable and profitable value chains of recovered resources.

• Define and implement an effective and well-targeted communication and dissemination strategy.
Working group: Drinking water resources

- Led by Reststoffenunie: Olaf van der Kolk
September 23rd 2014

Working group: drinking water resources
Scope

- Residuals from production drinking water (not distribution)

Residuals more or less the same across Europe:
- Drinking water produced from either groundwater or surface water
- The quality and volume may vary, but 6 or 7 residuals (iron sludge, alum sludge, filtersand/-gravel, softening pellets) represent > 90% of the volume
- For all residuals applications are available
- Applications for most residuals are available, but:
  - not always known
  - locally not developed
  - specific quality locally not available / developed
  - legal issues
  - individual water companies are not able to give guarantees on quality/quantity
Accelerating resource recovery

Indidual improvements simply identified, however, the strength is in the sector collectivity

Accelerating by:
- Learning from each other
- Tackling legal (European) issues
- Working together
  - supply chain
  - sales
  - business development
  - knowledge
  - ......
Step 1: inventory

- Geographical location
- Type of residuals
- Volume
- Application
- Costs
- Revenues

Start: Arreau Members?
Note: time consuming!
Step 2: analysis and actions

- Successes
- Unique applications
- (Legal) Issues to be tackled
- Shortages / surpluses in the market
- Where highest revenues / lowest costs

Actions....
Working group: Phosphorus from wastewater

• Led by KWB: Boris Lesjean
First meeting Action group ARREAU
Lisbon, 23.09.2014

Boris Lesjean, KWB
Update of working group « P-recovery and recycling »
Why P-recycling from municipal wastewater?

- Europe has a 92% import dependency on phosphate rock (80% fertilizer for agriculture)
- Since May 2014, phosphate rock in the list of 20 Critical Raw Materials of the European Commission
- 10 million t of sewage sludge produced yearly in the EU, about 36% is reused in agriculture
- Wastewater can supply another 12% of P-import
P-recovery from municipal wastewater?

100% P of load

20-70% of P load

10-70% of P load

*with acidic digestion

40-80% of P load (plant availability? contaminants?)

> 80% of P load

1. Ash after incineration
2a. Undrained sludge after anaerobic digestion
2b. Sludge liquor after dewatering
3. Direct agricultural utilisation of dewatered sludge

Already profitable!
Cost < 5€/p.e./a
Available technologies

- **Sludge/Sludge water**
  - Full-scale
  - Full-scale (planned)
  - Demonstration (planned)

- **Ash**
  - Leaching
  - Thermal

- **PEARL**
  - Struvite
- **NuReSys**
  - Struvite
- **Crystalact**
  - Struvite, CaP
- **AirPrex**
  - Struvite
- **LYSOGEST**
  - Struvite
- **REPHOS**
  - Struvite
- **PHOSPAQ**
  - Struvite
- **Gifhorn**
  - Struvite, CaP
- **KREPRO**
  - FeP
- **FIX-PHOS**
  - CaP/CSH
- **Ecobalans**
  - Struvite, NPK
- **ANPHOS**
  - Struvite
- **P-RoC**
  - CaP/CSH
- **STRUuvia**
  - Struvite
- **Budenheim**
  - DCP
- **LEACHPHO**
  - P-mineral
- **PASCH**
  - CaP
- **P-bac (INOCRE)**
  - Struvite
- **ECOPHOS**
  - DCP
- **SESAL-PHOS**
  - CaP
- **RECOPHOS D**
  - P-mineral
- **MEPHREC**
  - P-slag
- **AshDec (Outotec)**
  - P-mineral
- **THERMPHOS**
  - P₄
- **THERMPHOS**
  - H₃PO₄
- **NuReSys**
  - Full-scale (planned)
- **STRAVIA**
  - Struvite
- **Stuttgart**
  - Struvite
- **OUTOTEC**
  - P-mineral
- **THERMPHOS**
  - H₃PO₄

**www.p-rex.eu**
**ARREAU: Review of Best Practices**

<table>
<thead>
<tr>
<th>Case Study</th>
<th>Site</th>
<th>Description</th>
<th>Size</th>
<th>Contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>UK</td>
<td>Valorization of processed sewage sludge through pelletised quality organic fertiliser product (reference)</td>
<td>Full-scale</td>
<td>EU project End-o-Sludge</td>
</tr>
<tr>
<td>2</td>
<td>UK</td>
<td>Controlled use of sanitized sewage sludge in agriculture: UK “Safe sewage Matrix” (reference)</td>
<td>Full-scale</td>
<td>Anglian Water</td>
</tr>
<tr>
<td>3</td>
<td>France</td>
<td>Composting and End-of-Waste status (reference)</td>
<td>Full-scale</td>
<td>SEDE</td>
</tr>
<tr>
<td>3</td>
<td>UK</td>
<td>High quality products for agricultural valorisation / Biochar (reference in practice?)</td>
<td>Full-scale</td>
<td>EU project Refertil</td>
</tr>
<tr>
<td>4</td>
<td>Berlin / Mönchengladbach</td>
<td>Airprex process in sludge (struvite)</td>
<td>Full-scale</td>
<td>PCS / CNP</td>
</tr>
<tr>
<td>5</td>
<td>? (Flanders)</td>
<td>Nuresys process in centrate (struvite)</td>
<td>Full-scale</td>
<td>Aquafin</td>
</tr>
<tr>
<td>6</td>
<td>Offenburg</td>
<td>Stuttgart process in centrate (struvite)</td>
<td>Demo</td>
<td>Uni. Stuttgart</td>
</tr>
<tr>
<td>7</td>
<td>Slough / Amersfoort</td>
<td>Ostara process in centrate (struvite)</td>
<td>Full-scale</td>
<td>Thames Water</td>
</tr>
<tr>
<td>8</td>
<td>Nottingham</td>
<td>Phospaq (struvite)</td>
<td>Full-scale</td>
<td>Severn Trent Water</td>
</tr>
<tr>
<td>9</td>
<td>Nürnberg</td>
<td>P-recovery during/after thermal treatment (monoincineration ashes)</td>
<td>Demo</td>
<td>Mephrec</td>
</tr>
<tr>
<td>10</td>
<td>Varna</td>
<td>P-recovery during/after thermal treatment (monoincineration ashes)</td>
<td>Full-scale</td>
<td>Ecophos</td>
</tr>
</tbody>
</table>

**Criteria**

- Only municipal wastewater, no industry
- Only technologies/practices with large scale references
- General Best Practices to be addressed in cross-cutting activities (wastewater collection and treatment, banning of o-PO4 etc)
Next steps for Working Group “P-recovery”

- Production of Fact Sheets by EIP Water day
- Contribution to « cross-cutting » WG
- Check of TERRY tool from WERF ?
- Other ?
Working group: Cellulose from wastewater

- Led by BWA: Coos Wessels
Cellulose from wastewater

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Coos Wessels
Facts and figures

- Toiletpaper is appr. 30-50% of the Total Suspended Solids (TSS);
- Representing 25-45% of the COD;
- Western Europe average 12-16 kg toilet paper per person;

NL: 150,000 to 180,000 ton TSS/year!
Screenings a new site product

- *Finescreens, they are of added value!*

- **Challenges:**
  - How do we get the maximum added value from screenings;
  - Where can we use the cellulose recovered
An innovative way of maxgrading

Biofuel
- Biogas
- Biodiesel

Basic chemicals

Use as a fiber
- Carton board
- Composite

Bioplastic
Re-processing Routes

**SCREENCAP**
Impact on downstream biological treatment

**Waterboards**
Screening of toilet paper from sewage, using a finescreen

**CADOS**
Screenings as raw fiber material
Use for sludge dewatering

**CelluSCycle**
Screenings as carbon source

**Cellulose from sources**
- Paper;
- Diapers;
- Beverage carton;
- Textile
Speedy composting with Fibral and compost reactor
Different WWTP, eg. Kulstad (NO)

- Recirculated newspaper
- Added absorbent (polymer)
- 4-6% additive to sludge
  - (Other composting methods must have 100-150% addition of structural fiber (from trees and bushes/ garden waste)
Optimisation of sludge dewatering
WWTP Ulrum (NL) – started 19-09-2014

Capacity: 20,000 pe
DWF: 107 m$^3$/h
FFT: 457 m$^3$/h

Screenings 30 - 70 kg Ds/h (dewatered)

Improve dewatering to >30% Ds
Reduction polymer consumption to < 3 g/kg Ds

Possible dosage of cellulose from other sources
Optimisation of sludge dewatering
WWTP Ulrum (NL) – started 19-09-2014

3 years research period

Projectpartners:
Optimisation of sludge dewatering
WWTP Ulrum (NL) – started 19-09-2014

This project is co-funded by “Samenwerkingsverband Noord Nederland, the Provinces of Drenthe, Fryslân and Groningen through a subsidy under “Pieken in de Delta, Koers Noord”.”
Production of Bioplastics (PLA)
WWTP Beemster - under construction

Capacity: 170,000 pe
DWF: 1,860 m$^3$/h
FFT: 3,600 m$^3$/h

Screenings 770 ton Ds/y

Production 130 ton PLA/y

Challenges:
- Separation of clean cellulose fiber
- Tests for using cellulose in composites
Production of Bioplastics (PLA)
WWTP Beemster - under construction

3 years research period

Projectpartners:
Production of Bioplastics (PLA)
WWTP Beemster - under construction

The research phase of this project was co-funded by the “Rijksdienst voor Ondernemend Nederland (RVO), through a subsidy under the TKI-BBE.

The demonstration phase of this project is co-funded by the European commission, through a subsidy under the LIFE+. 
Separation of cellulose fibers
WWTP Uithuizermeeden (NL) – start 01-01-2015

Capacity: 55,000 pe
DWF: 465 m³/h
FFT: 860 m³/h

Screenings 130 ton Ds/y

Focus:
➢ Getting clean cellulosic fibers as raw material for composit
Bio-Based ladder

- From low-grade residue to high-grade raw material;
- Through innovation:
  - Eliminate food competition (PLA=98% maïs)
  - Significant energy savings and reduction of sludge growth;
  - Production of bio-based products for a global growth market.
- Economic Sustainability;
- Social importance and high potential domestic and global
- Cooperation of Partners that have the right knowledge, experience and track record.
So far! Questions?

“We cannot solve our problems with the same thinking we used when we created them”

- Albert Einstein -
Wrap up

• Framework proposal by Ashish (by email)

Follow up:

• First EIP water conference 5-6th November, including booth! Message: resource recovery from water pays off: proven by examples. Opportunities and barriers/bottlenecks. Ideas and facts necessary