Run4Life

Recovery and Utilisation of Nutrients 4 Low Impact Fertiliser

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A change is needed

- Domestic wastewater is an important nutrient carrier
  - Currently not exploited – nutrients are wasted

- Run4Life demonstrates a necessary change, with nutrient recovery at the source in a decentralised approach from segregated flows
  - Black water (BW), kitchen waste (KW) and grey water (GW)

- Innovative technologies for enhancing nutrient recovery are integrated with near-market complementary fertiliser concepts
Run4Life consortium

Demonstration sites:
- Sneek, the Netherlands: 32 homes
- Vigo, Spain: 3 office buildings
- Ghent, Belgium: 120 homes
- Helsingborg, Sweden: 320 homes
- Czech Republic: large industrial area
  (possible replication site)

15 partners
Start Date: 01/06/2017
End date: 31/05/2021
EC Contribution: 6.239.340
Ambition

Potentially recycling up to 100% of the nutrients present in household WW and organic KW (N, P, K and micronutrients)
Recovering >90% of GW as reclaimed water
Energy Positive and Carbon Neutral

Nutrient recovery processes can be tailored to specific local priorities and will be slightly varied to adapt Run4Life to local conditions and requirements

Break barriers to implementation: market uptake of products and social acceptance,

Necessity of further developments in technological, legal and end-user aspects.
Objectives

- Improve innovative nutrient recovery technologies
- Demonstrate large scale nutrient recycling from domestic wastewater
- Evaluate impacts on environment, society and economy
- Promote full acceptance of recovered products, review legal framework
- Implement value chain for recovered products, incl. new business models
Figure 20. Pert diagram of Run4Life.
General technological concept

Black water (BW) comes from toilets, mainly containing faeces and urine. It presents the majority of the P and N in household WW, which can be recovered as highly valuable fertiliser products.

Grey water (GW) comes mainly from shower and laundry activities. Its low nutrient concentration makes more suitable for reuse and obtaining reclaimed water.

Kitchen waste (KW) contains a high percentage of the domestic-generated P and N, as well as most of the organic material in a relatively small volume.
Nutrient-recovery Technologies developed by R4L

Ultra-low flush vacuum toilets

- The novel ultra-low flush vacuum toilet developed by JETS works with a flushing water volume of 0.4-0.7 liter.
- Compared to traditional water saving toilets, a substantially lower water consumption and higher nutrient concentration in the blackwater is achieved.

![Diagram showing flushing volume comparison between different toilet types.](image)
Nutrient-recovery Technologies developed by R4L
Hyper-thermophilic treatment (HTAD)

Hyper-thermophilic anaerobic digestion of concentrated black water:
- One-step treatment
- Aims to recover the phosphorous and nitrogen in the hygienised effluent
- Ready to use as fertilisers
Nutrient-recovery Technologies developed by R4L

Bio-electrochemical systems (BES)

BES recovers up to 12.8 g/m² of nitrogen present in blackwater as liquid fertilizer (ammonium nitrate)
Run4Life Demonstration sites
Demonstration site at Ghent, Belgium

- Segregated black water + kitchen waste will be processed in an anaerobic system. Grey water will be treated in a system not included in Run4Life.
- Recovery of struvite and phosphoric acid.

RESIDENTIAL WASTEWATER

- H2020- R4L
- VACUUM TOILETS
- BLACK WATER
- ANAEROBIC DIGESTOR (UASB)
- AEROBIC SLUDGE
- KITCHEN WASTE
- BIOGAS
- INCINERATION (AQUAFIN)
- ENERGY
- N-RECOVERY
- STRUVITE
- GREY WATER
- AEROBIC WATER TREATMENT (aMBR)
- EFFLUENT WATER
- REVERSE OSMOSE
- SOAPFACTORY CHRISTEYNs
- HEATPUMP
- LOCAL GREEN AREAS
- WASTE HEAT

Horizon 2020, GA 730285.
Demonstration site at Vigo, Spain

- Vigo, Spain
  - Grey water recycling system (already present): effluent for toilet flushing.
  - Black water treated in anaerobic MBR (compared to aerobic MBR).
  - Anaerobic effluent processed in innovative nutrient recovery technologies e.g. bio-electrical systems, recovery of ammonium nitrate and struvite.
  - Integrated value chain with online monitoring tool.

Flow diagram:
- Blackwater 1.5 m³/d
  - GW recycling system
  - AnMBR
  - Fluidized BES
  - Biogas
  - Solid NPK fertiliser
  - Fluidized BES Pre-Pilot reactor: 5.4 L
  - Fluidized BES Pilot reactor: 450 L
  - Reclaimed water
  - UV LED / Ozone / GAC
  - AGRICULTURE

- Greywater

- Liquid NPK fertiliser
  - Concentration
  - Ammonium nitrate

- UV LED / Ozone / GAC
  - Reclaimed water
Demonstration site at Sneek, the Netherlands

- Ultra low flush vacuum toilets for production of concentrated black water.
- Hyper thermophilic anaerobic digestion at 70°C aimed at obtaining safe fertilisers in a one-step energy positive treatment.
- Recovery of hygienised organic liquid and solid (NPK) fertilizer.
- Optimisation of product recovery in cooperation with fertilizer company.

Ultra low water consumption vacuum toilets → Concentrated BW 0.2 m³/d → Biogas → HTAD → NPK Liquid Fertiliser → NPK Solid Fertiliser → AGRICULTURE
Demonstration site at Helsingborg, Sweden

- Separate treatment of black water and kitchen waste
- BW and KW will be treated in an anaerobic system for energy recovery
- Ammonium sulphate and struvite will be recovered

![Diagram of demonstration site]

- Blackwater → Anaerobic digester → Sludge
- District heat → Anaerobic digester
- Food waste → Anaerobic digester
- District heat

- Struvite precipitation
- Ammonia stripping
- Mineral fertilizer products
- Mix in to pellet with fixed NPK ratio (Using dewatered food waste sludge only)
- Discharge of liquid effluent
- Reject to greywater treatment line (not part of Run4Life project)
- District heat
- Fertilizer product
- Existing national sludge certifications (SPCR 120)
How does Run4Life test quality and safety of the fertilizers and technologies to obtain those?

- Pot tests
- Field trials
- Risk assessment
- Life cycle assessment

How does Run4Life maximize the impact beyond the lifespan of the project?

- Social acceptance analysis
- Communication & dissemination activities
- Exploitation and Market uptake analysis
Run4Life will make possible the transition to a Circular Economy of nutrients incorporating four dimensions economic, social, legal and environmental

**Impact 1.** Decreasing the dependency on primary nutrient resources and increasing European supply security

**Impact 2.** Reducing the adverse effects of nutrient emissions on the environment

**Impact 3.** Closing the water and nutrient cycles in the whole production and consumption value chain

**Impact 4.** Improving data quality on nutrients flows, to favour investments into recycling of recovered nutrients

**Impacts 5&6.** Creating new business opportunities in the EU, to generate new green jobs and export industries around nutrient recovery and recycling, Contributing to the exploitation of EU innovative solutions in the global market

**Impact 7 & 8.** Improving the policy and market conditions in Europe for large scale deployment of innovation. Providing evidence-based knowledge regarding the enabling framework conditions that facilitate a broader transition to a Circular Economy in the EU.
Find out more about Run4Life