



Recovery and Utilization of Nutrients 4 Low Impact Fertilizer

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Public presentation

Run4Life Review Meeting
Brussels, 5th February 2019



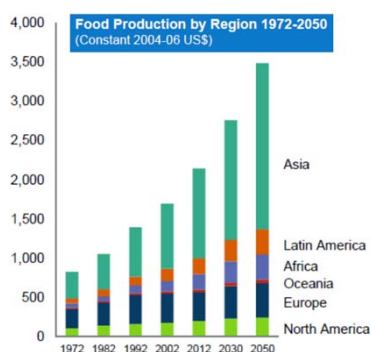
The Run4Life project receives funding from the EU Horizon 2020 Research and Innovation programme, under G.A. No 730285.



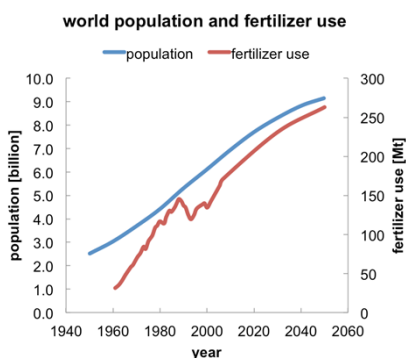
Run4Life Review Meeting Brussels, 5th February 2019

Context

- Growth and urbanisation of population ↑
- Global demand for food ↑
- Demand for fertilisers ↑



California Environmental Associates (2013), FAO 2012.



Mengyao Yuan (2014). Data from N. Alexandratos and J. Bruinsma, "World Agriculture Towards 2030/2050: The 2012 Revision," FAO 2012

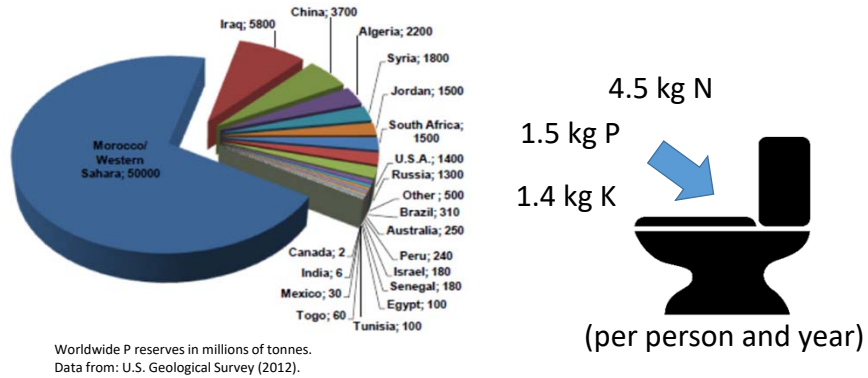


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Context




- Phosphorus. No renewable. Localised reserves.
- Nitrogen fixation, energy demanding (10-15 kWh/kg N)
- Wastewater: important carrier of nutrients



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Context

- Conventional, centralised and linear approach: old concept of *Cloaca Maxima* → Only recover a small fraction of diluted nutrients

[Cloaca Maxima From: Wikipédia](#)
- Municipal WWTP removes 80-90% of the P and >70% of N → At considerable expense (5 kWh/kg N)

- Highly diluted municipal WW → Nutrient recovery very limited


From Wikimedia Commons. US Department of Agriculture



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Run4Life change of concept

- To apply nutrient recovery **at the source**, increasing **recuperation** rates by treating **concentrated streams**.

Attractive alternative where:

- centralised system do not exist (e.g. rural/isolated areas, new buildings and developments and new cities in developing countries)
- existing sewerage is old/leaky and its replacement/upgrade is too costly
- existing WWTPs are overloaded.



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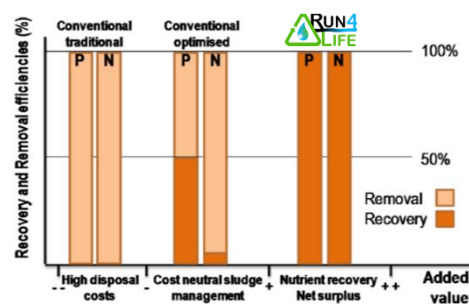
Run4Life decentralised approach combined with...

Three strategies:

- Separation of streams at source for process optimization
- Technological innovations applied at various points of the process
- Business Model innovation

... to achieve:

- 2 fold P recovery
- 15 fold N recovery



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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.**



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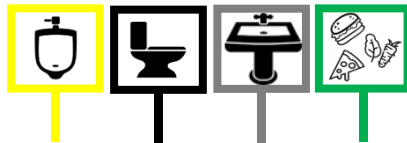
Ambition



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Run4Life WW segregation...



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.



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Run4Life partners

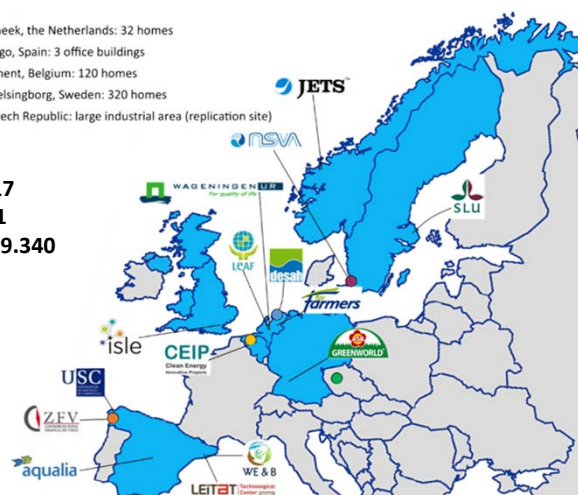
- Sneek, the Netherlands: 32 homes
- Vigo, Spain: 3 office buildings
- Ghent, Belgium: 120 homes
- Helsingborg, Sweden: 320 homes
- Czech Republic: large industrial area (replication site)

15 partners

Start Date: 01/06/2017

End date: 31/05/2021

EC Contribution: 6.239.340



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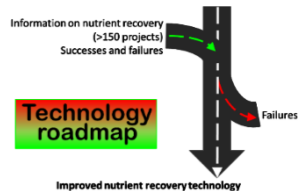
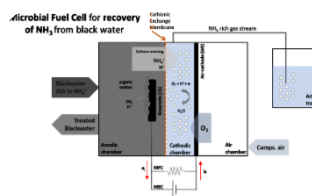
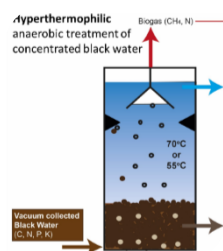
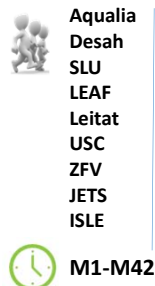
Run4Life two virtuous cycles for nutrient recovery become a success



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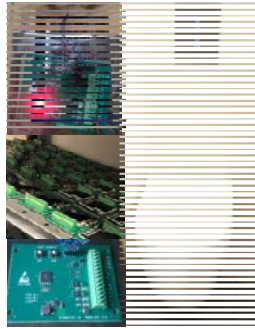
Run4Life technological innovations...



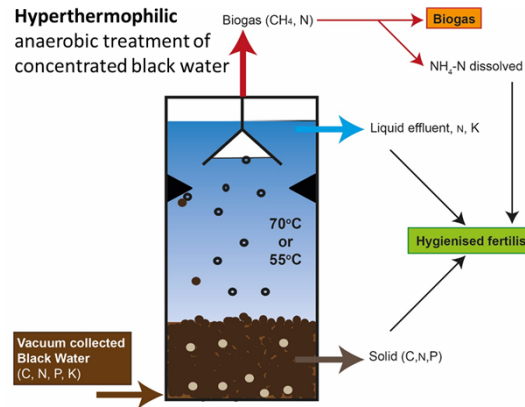
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Run4Life technological innovations...



Ultra low flush vacuum toilets for production of concentrated black water

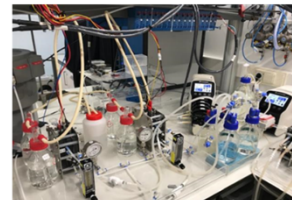
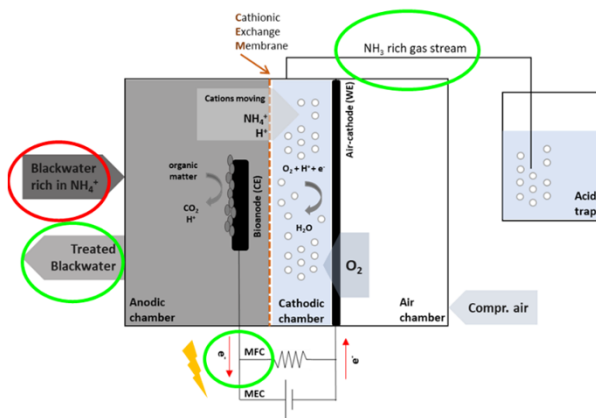


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Run4Life technological innovations...

Microbial Fuel Cell for recovery of NH_3 from black water

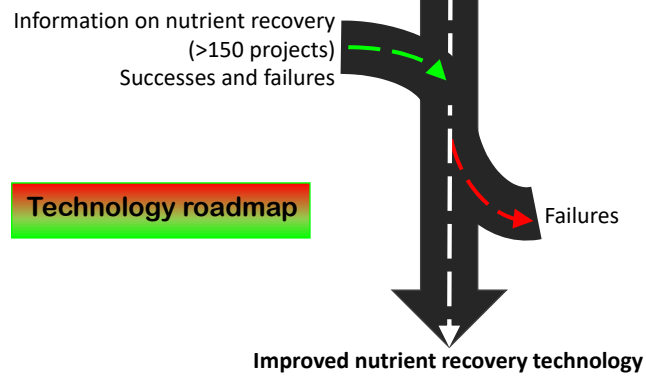


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Run4Life technological innovations...

Run4LIFE technologies for decentralised treatment of segregated domestic wastewater streams and organic kitchen waste



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Run4Life large scale demonstration...



WP3

Aqualia
LEAF
Leitat
NSVA
USC
WU
ZfV
JETS
CEIP



M3-M47



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Ghent, Belgium

- Segregated black water (conventional vacuum toilet) + kitchen waste processed in an anaerobic system.
- Grey water treated (in a system not included in Run4Life).
- Recovery of struvite and phosphoric acid
- Heat recovery from WW
- Water recovery for industry

420



Vigo, Spain

- Grey water recycling system: recovery for toilet flushing
- Black water (conventional toilet) treated in anaerobic MBR
- Anaerobic effluent processed in innovative nutrient recovery technology e.g. bio-electrical system, recovery of ammonium nitrate and struvite
- Integrated value chain with online monitoring tool

3



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Sneek, The Netherlands

- Ultra low flush vacuum toilets for production of concentrated black water
- Hyperthermophilic anaerobic digestion at 70°C aimed at obtaining safe fertilizers 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

32



Helsingborg, Sweden

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

320



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Recovered products evaluated from the end-users' perspective...



WP4

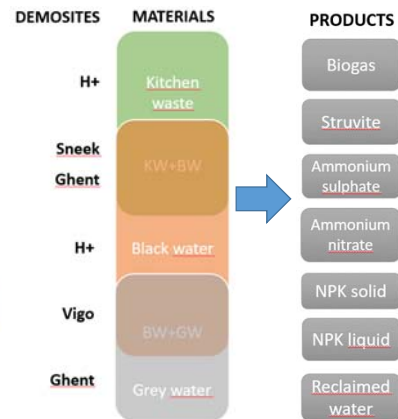


Aqualia
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WU
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4F
ASB



M3-M48

Prove quality and safety of Run4Life fertilisers and reclaimed waters so that they can be employed as commercial resource



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Pot and field experiments comparing new products with commercial fertilisers



- Fertiliser characterisation
- Seed germination/Root Elongation
- Earthworm, Acute Toxicity Test
- Optimisation of dosage
- Three soils and two crops
- Yield: dry matter, crude protein



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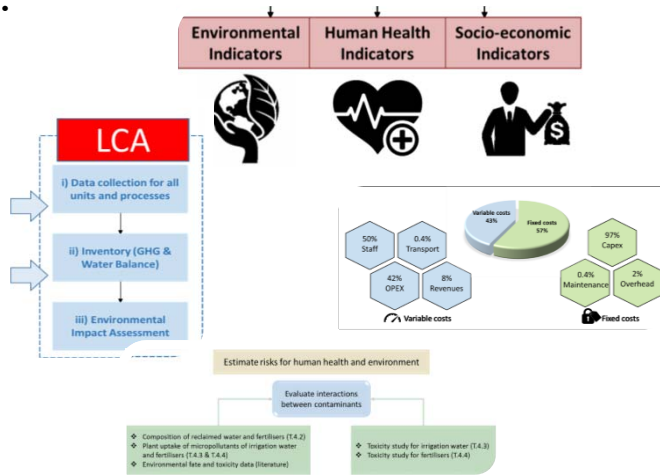


Run4Life is environmentally and economically evaluated...

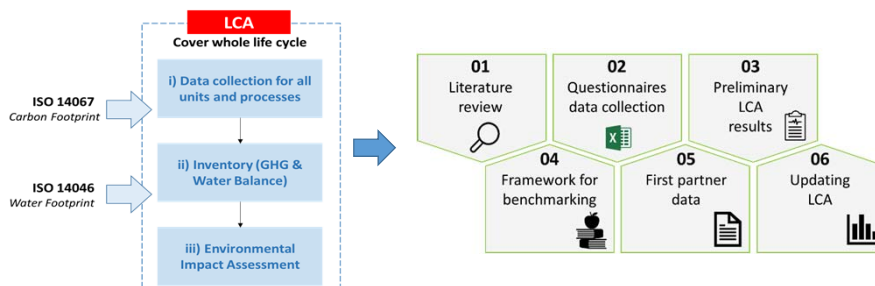
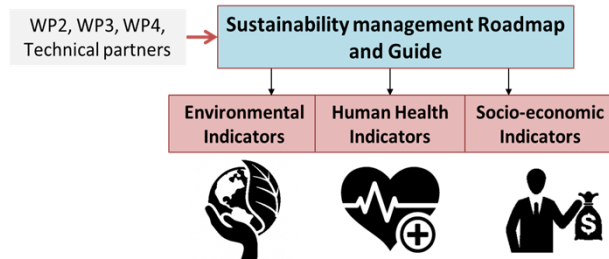


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M1-M48

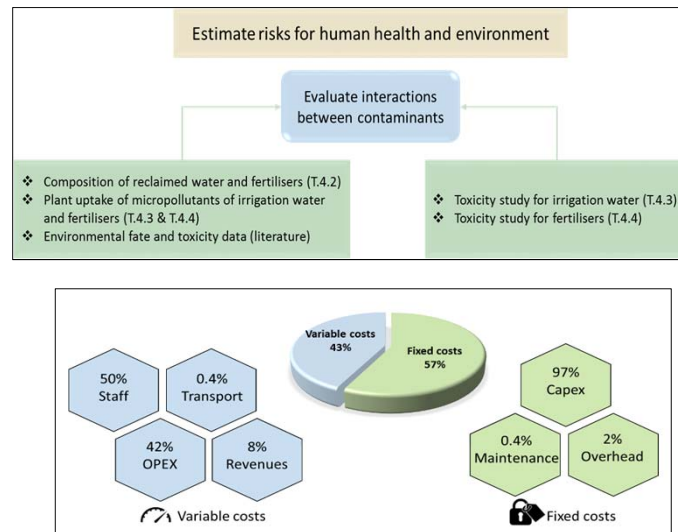


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WP6

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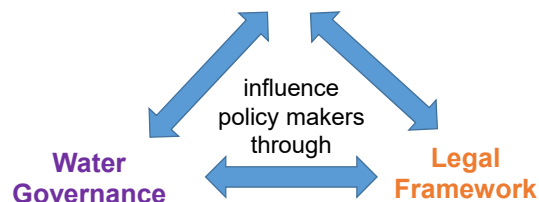
M1-M48

**Environmental, Technical
and Health Assessment**

**End-users'
perspective**

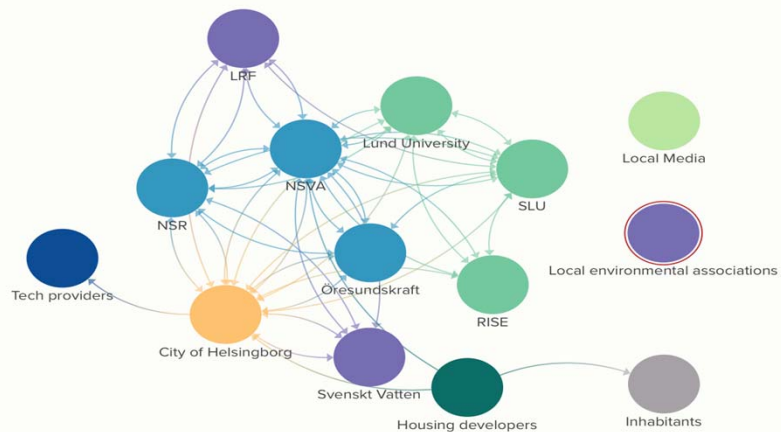


Social Acceptance

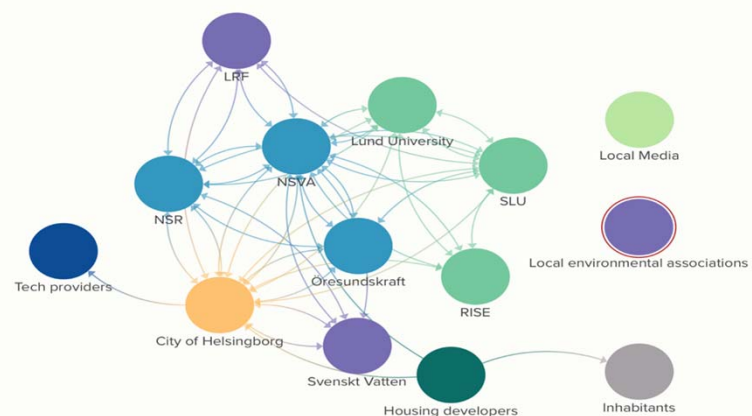


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Exploitation and Market Uptake



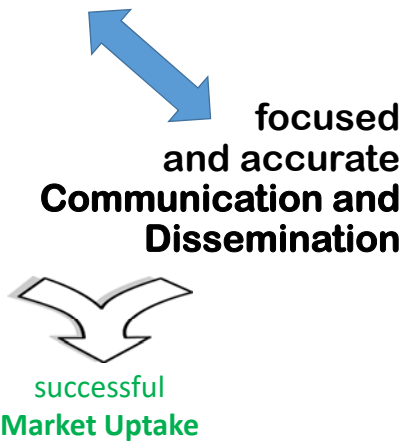
WP7



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JETS
CEIP
4F
ASB



M1-M48



WP8



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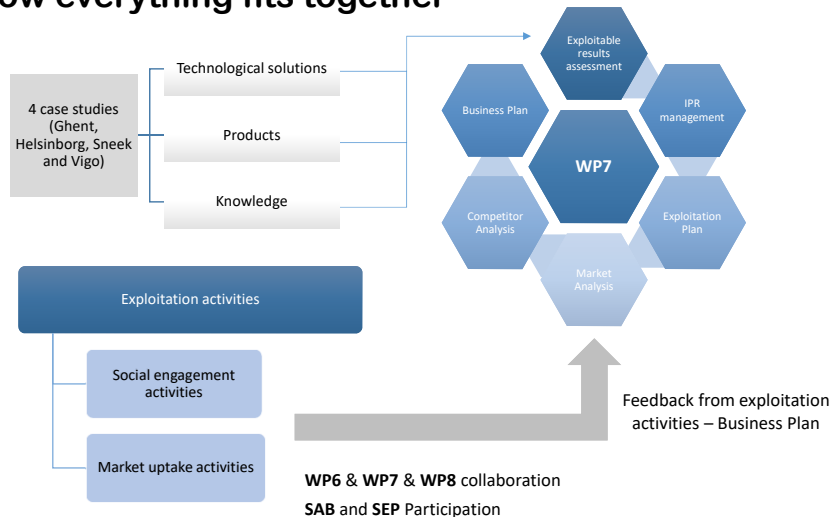
M1-M48



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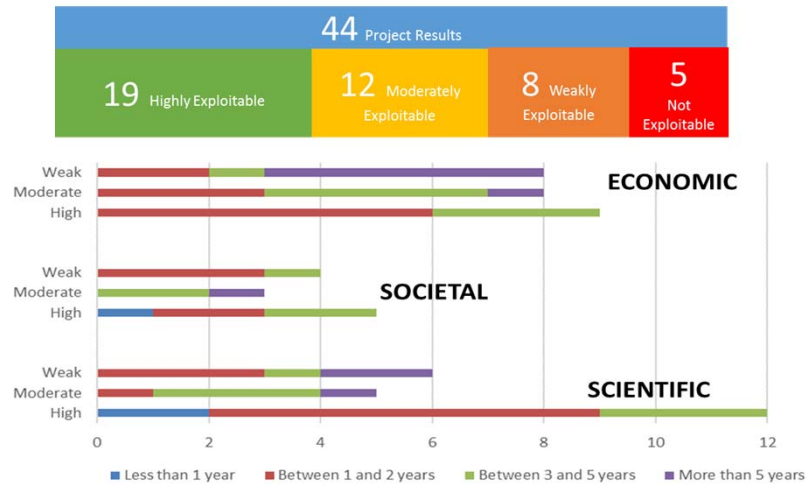
How everything fits together



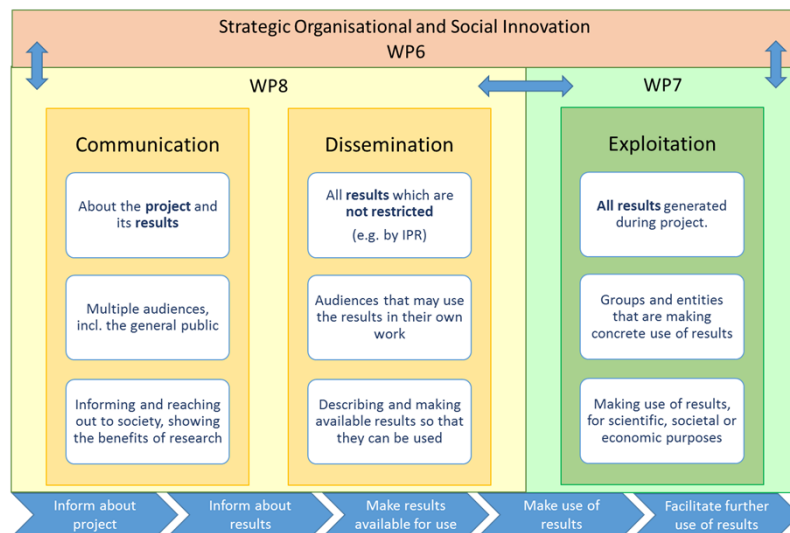
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Impact



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60 publications and news items

Potential reach:
>200,000



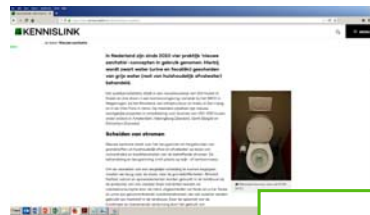
elEconomista Magazine



M6 meeting
Vigo Newspaper



Recolab
brochure



Nemo Kennislink



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50 Face to face activities

Reach: ~5000 people
Potentially: >350,000

Vigo – EU
Roadtrip
project



IWA WWCE
Tokyo



IWA S2SMALL
2017



IFAT
Stakeholder
event



Ecomondo

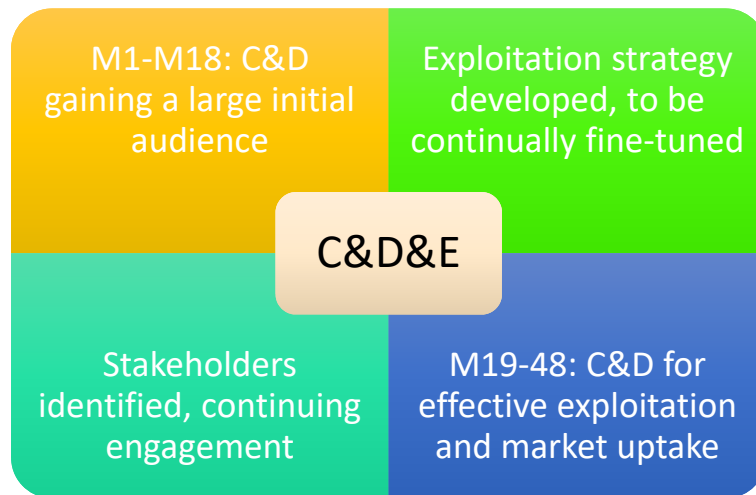


EU-ISMET
2018

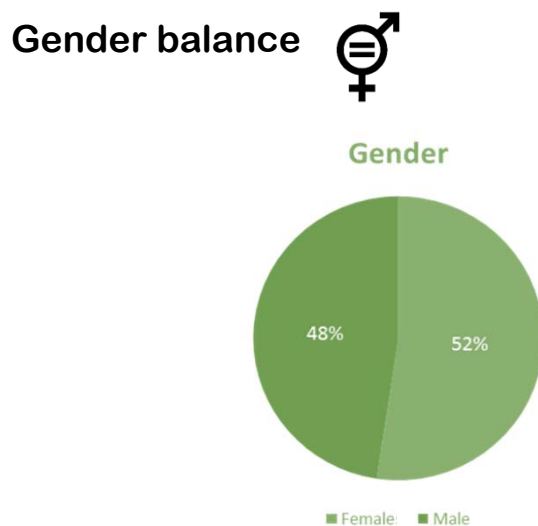


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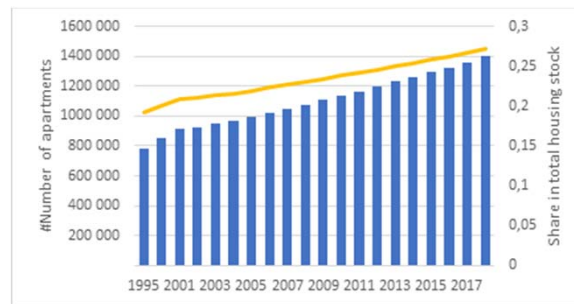
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Potential market (6 SME)

In 2018, **40.000** extra apartment units were constructed
of which **30% in the 5 largest cities in Belgium**.

Investments in new Decentralised WTS could amount to **>12 M€/yr** by 2030,
giving 1/3 newly built sector access to **sustainable services**.



Belgian administration FOD Economie (2018)



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Projects



- Buiksloterham, Amsterdam, 600 houses (2019),
- Nijkerk, 1000 houses (2020),
- Groningen, 200 houses (2019),
- Kerkrade, 125 apartments (2020),
- Amsterdam, Strandeiland, 8000 houses (2023),
- The Hague, office of Ministry of Environment, 6000 employees (2018)



- Edmonton, 1500 people (2019)
- Stockholm, 800 apartments (2021)
- Hamburg 2018 (Germany)



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Conclusions

- Four different demosites (2000 people)
- 3 innovative technologies
- 7 fertilizers, tested in the field
- Energy positive and carbon neutral infrastructure
- 19 highly exploitable results
- 6 SMEs
- SAB and SEP
- 400 web visits/month, 500 followers



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Thanks for your attention



Questions?



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