



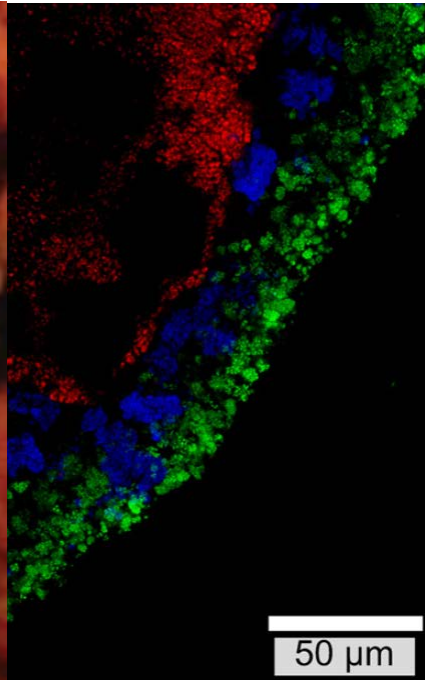
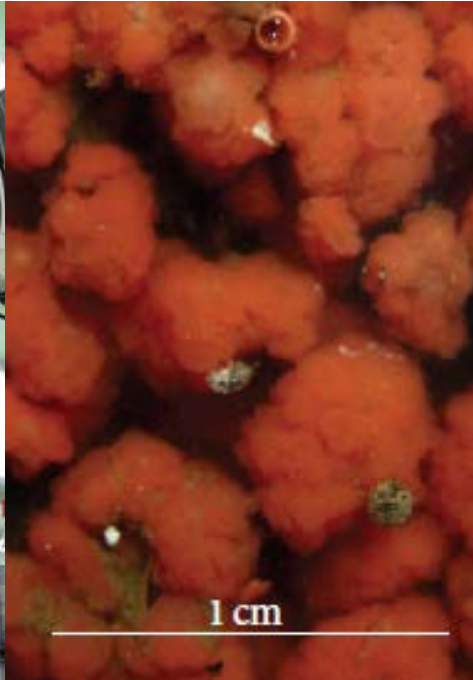
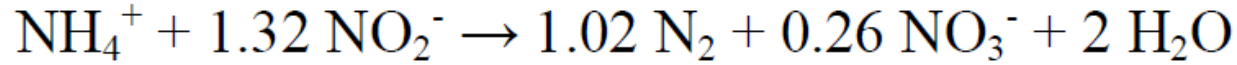
A' utilities guide to starting up Anammox

Water NZ Conference 2018



ANAMMOX

(Anaerobic Ammonium Oxidation)



- **It is a Microbe**
- **It is a Process**
- **Discovered in 1995**

(Strous et al, 1998. Appl Microbiol Biotechnol 50: 589-596; Vlaeminck et al, 2010. Appli.Env.Microbiol 76, 900-909; Ni et al, 2013. BioMed Resch 469360;)

THE ENERGY NEUTRALITY PROGRAMME

The goal:

2025

To achieve energy neutrality at our Rosedale and Mangere wastewater treatment plants by the end of 2025. We need to make efficiency gains of 37 GigaWatt hours.



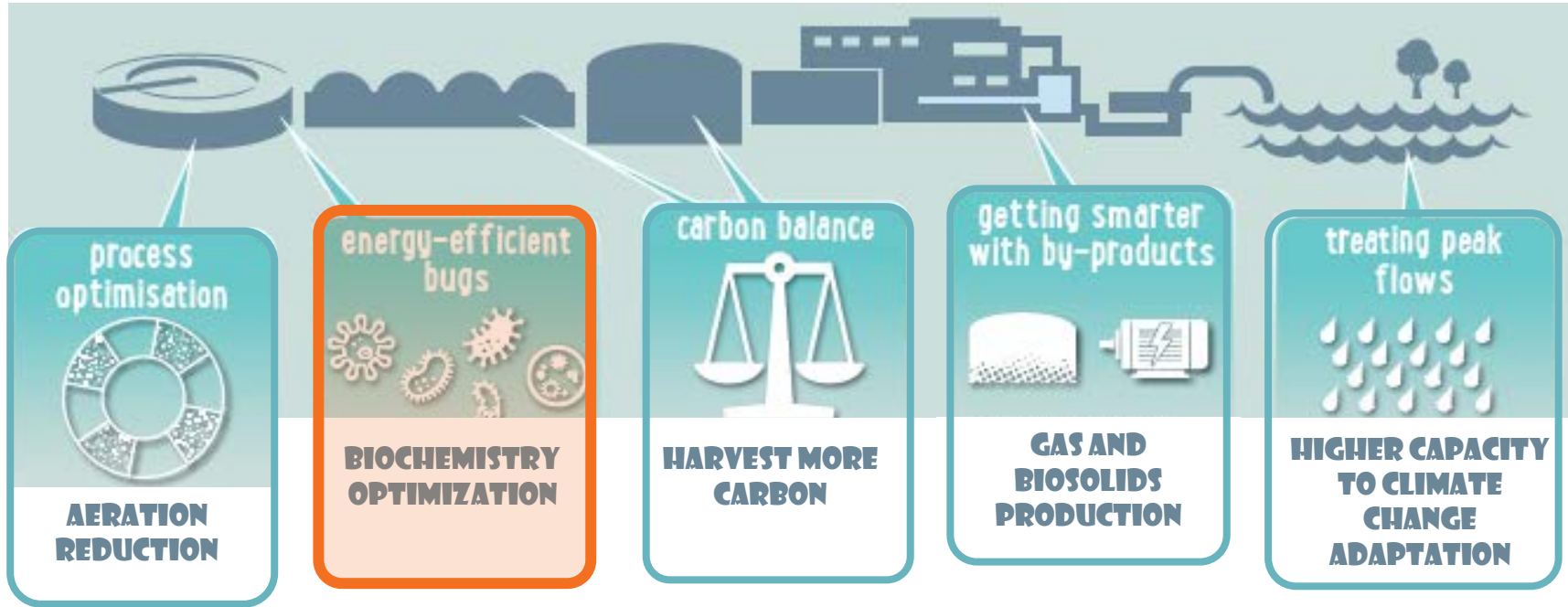
Rosedale WWTP



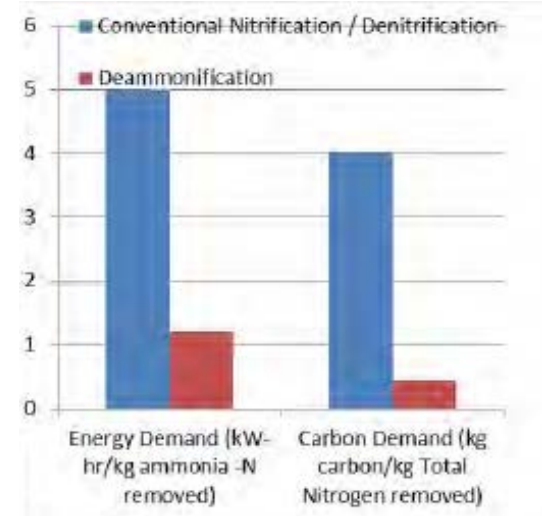
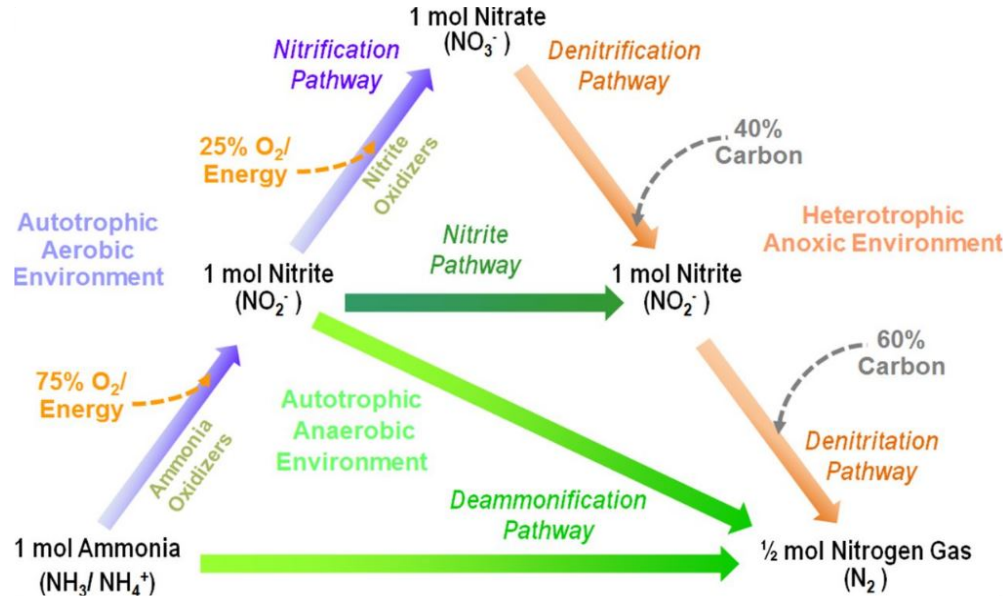
Mangere WWTP



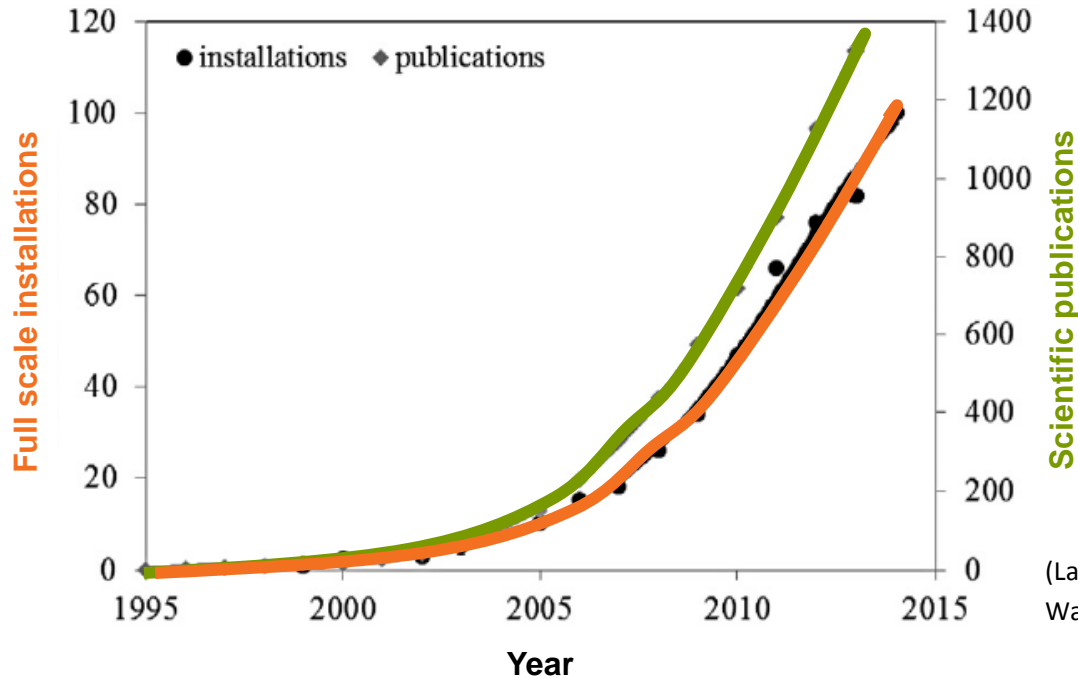
THE ENERGY NEUTRALITY PROGRAMME



BIOLOGICAL NITROGEN REMOVAL FROM WASTEWATER



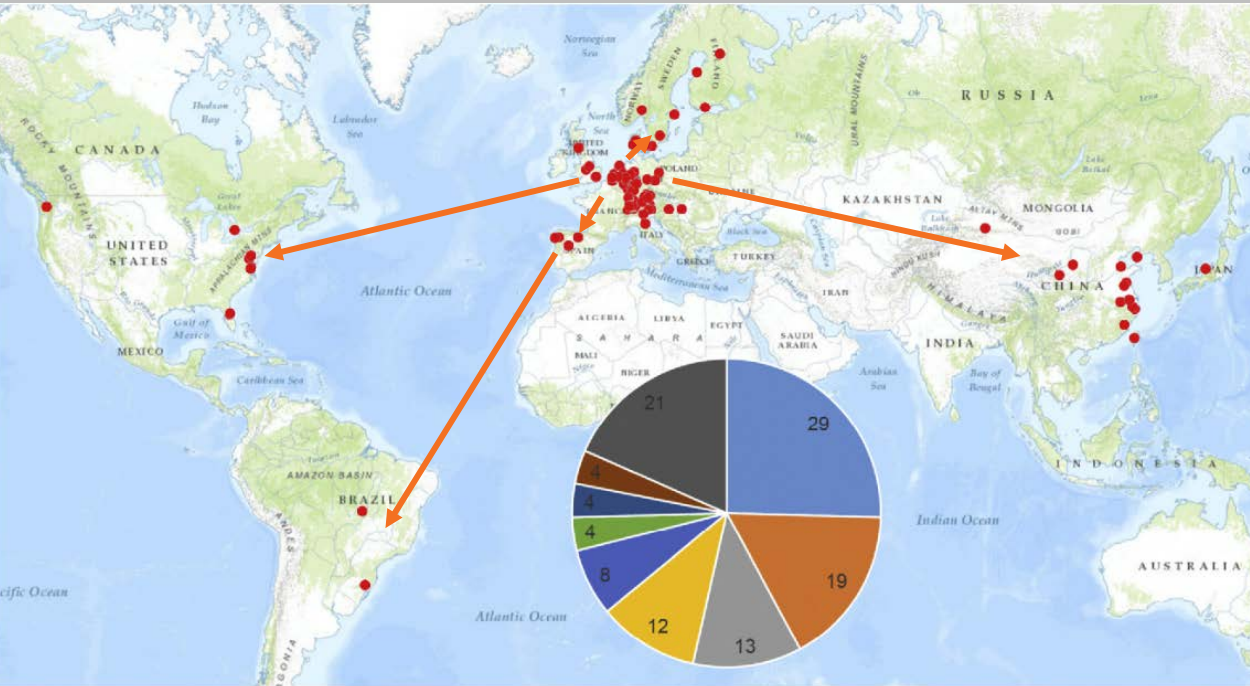
THE BOOM OF ANAMMOX TECHNOLOGY



Exponential use and study of anammox microbes for wastewater treatment

(Lackner et al, 2015.
Water Research 55, 292-303)

THE BOOM OF ANAMMOX TECHNOLOGY

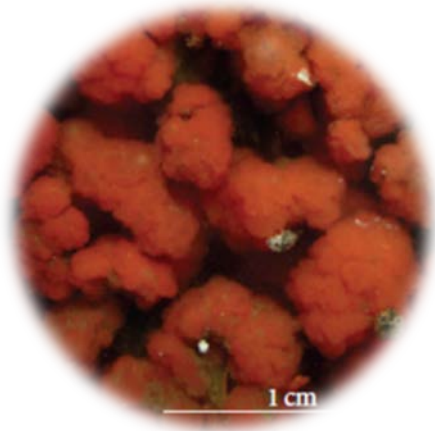


Bugs on a quest for world domination

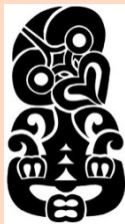
(Ali et al, 2015.
Chemosphere 141, 144-153)

HOW SHALL WE START?

We need the bugs!



Import them
from overseas



Develop our
native strain



NATIVE ANAMMOX IMPLEMENTATION PATHWAY

1.Genetic detection

2.Enrichment

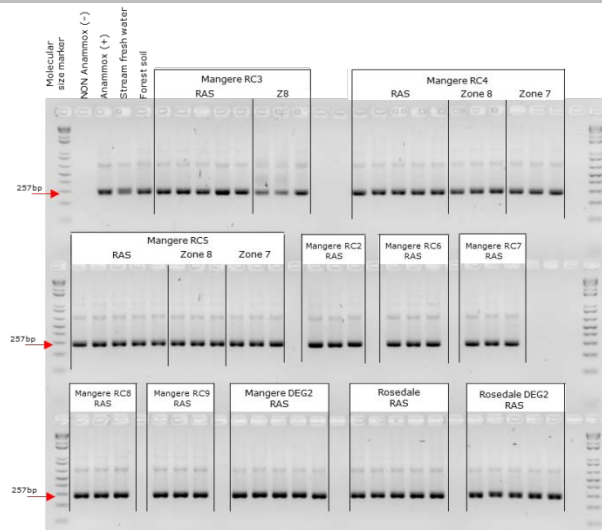
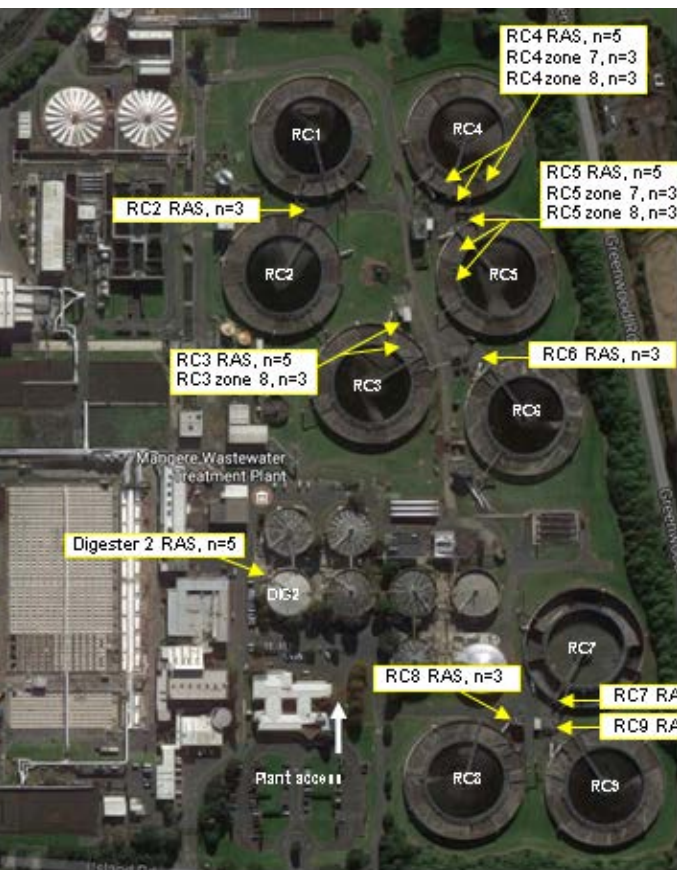
3.Scale-up

4.Pilot trials

5.Construction

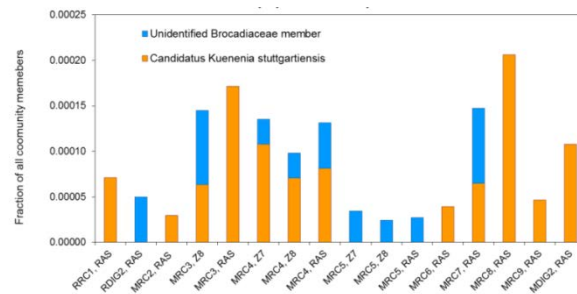
6.Commissioning

1. DETECTION



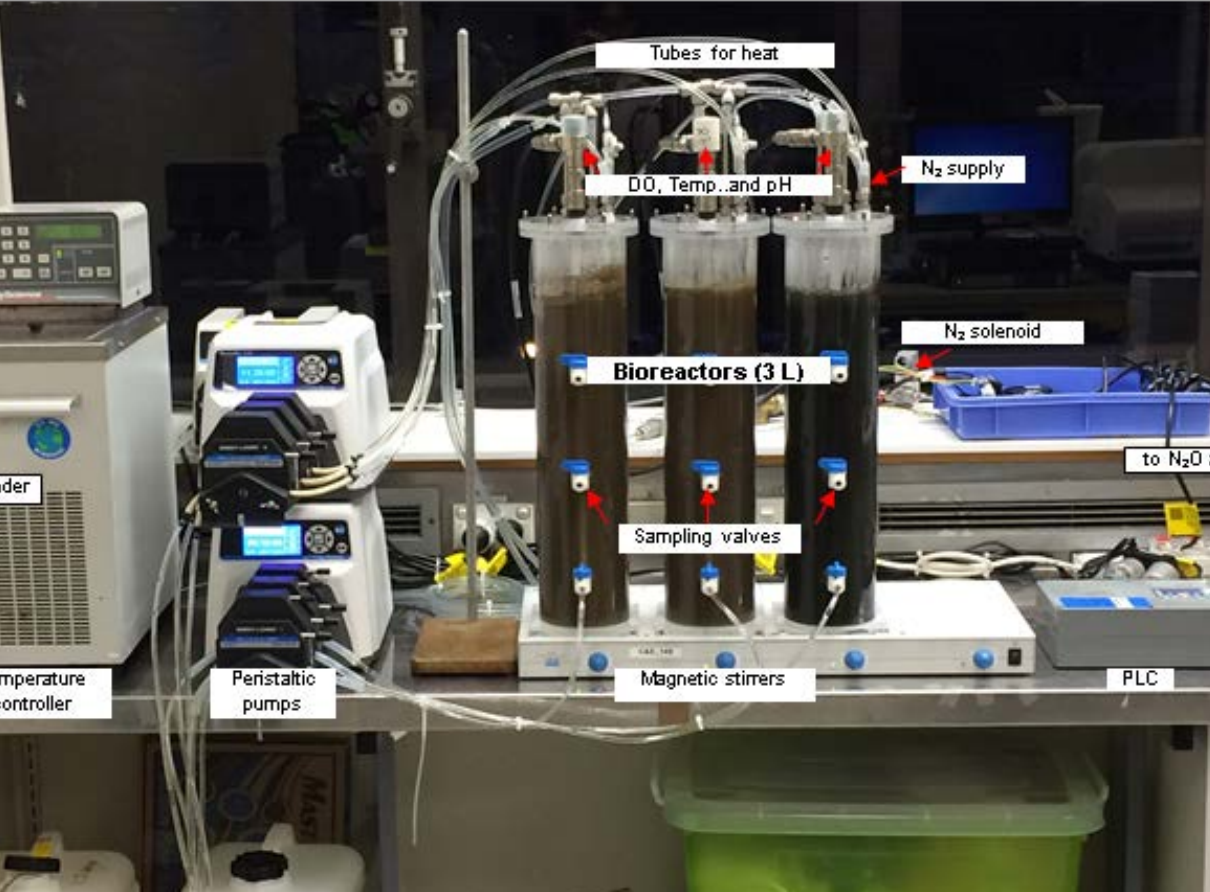
Successful genetic detection in almost 60 wastewater samples

Presence at very low concentrations



Two identified species

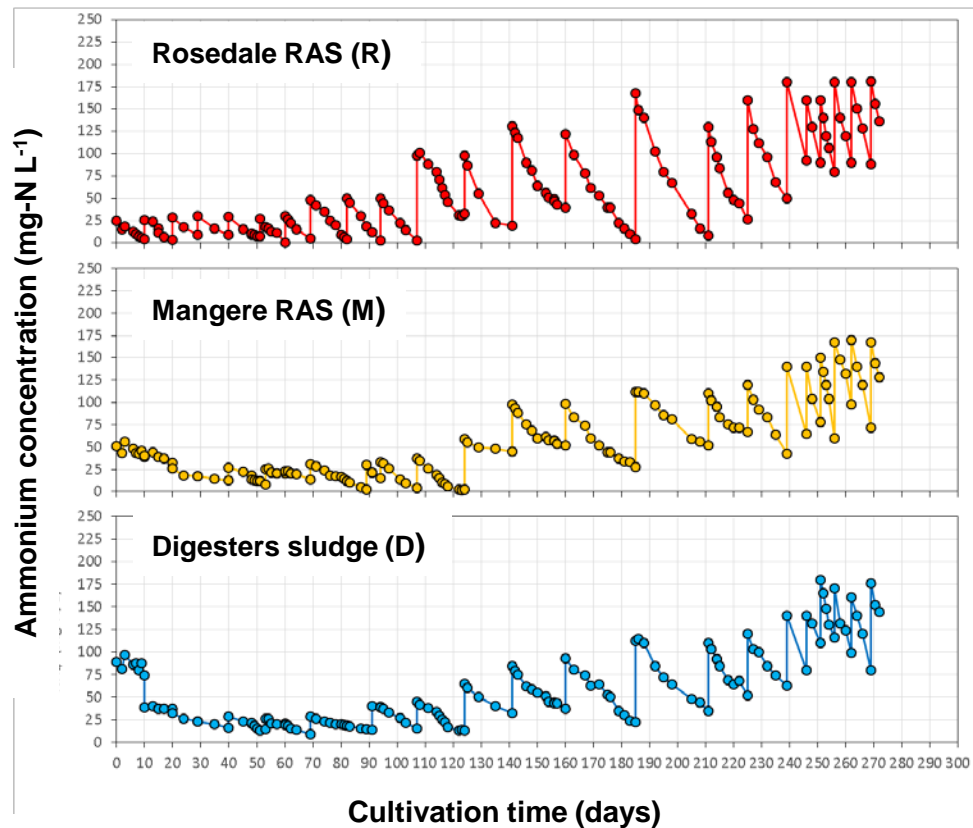
2. ENRICHMENT



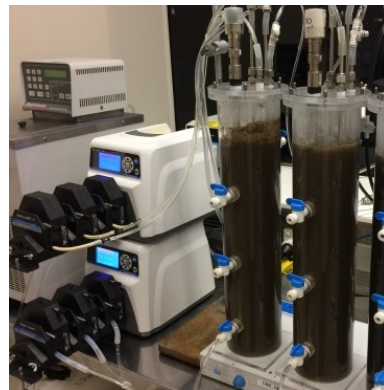
Three wastewater samples each cultivated in a SBR bioreactor (3L)

- Mangere RAS (R)
- Rosedale RAS (M)
- Digesters sludge (D)

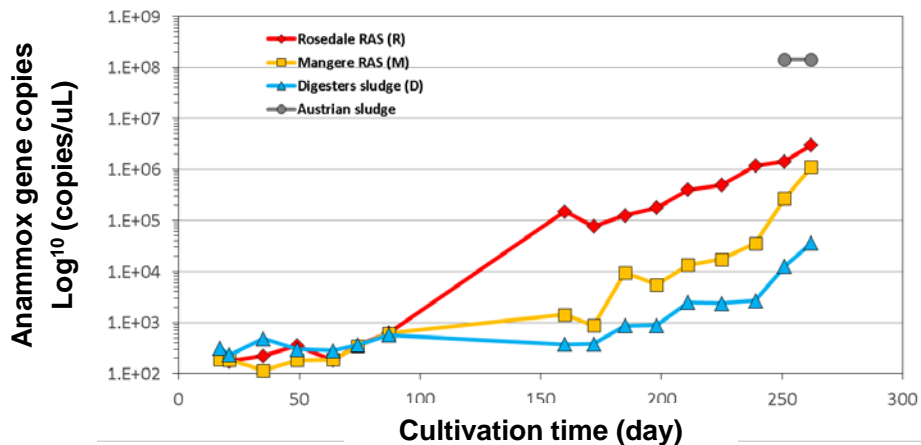
2. ENRICHMENT



**Positive results
(NH₄⁺ consumption)
for all three reactors
after 250 days of
cultivation**

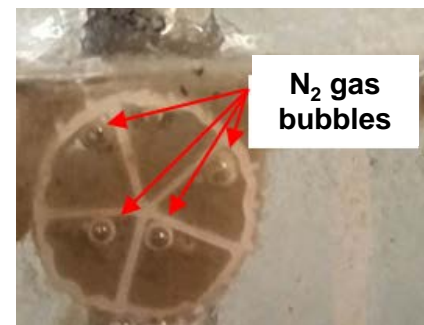
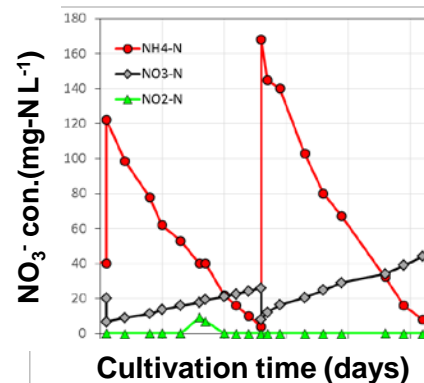
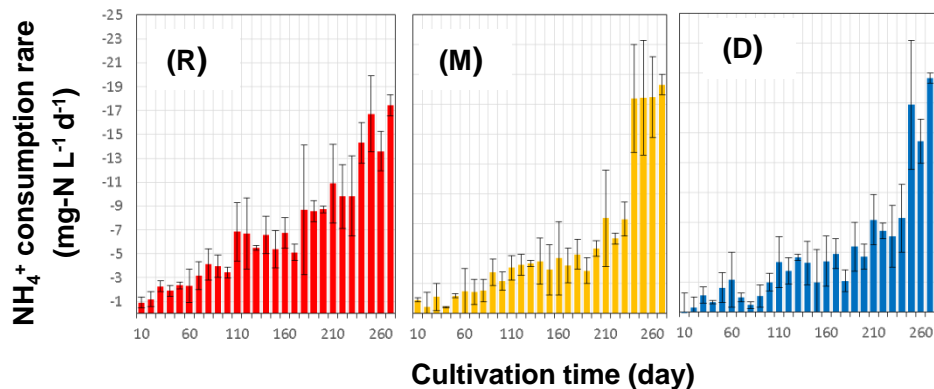


2. ENRICHMENT

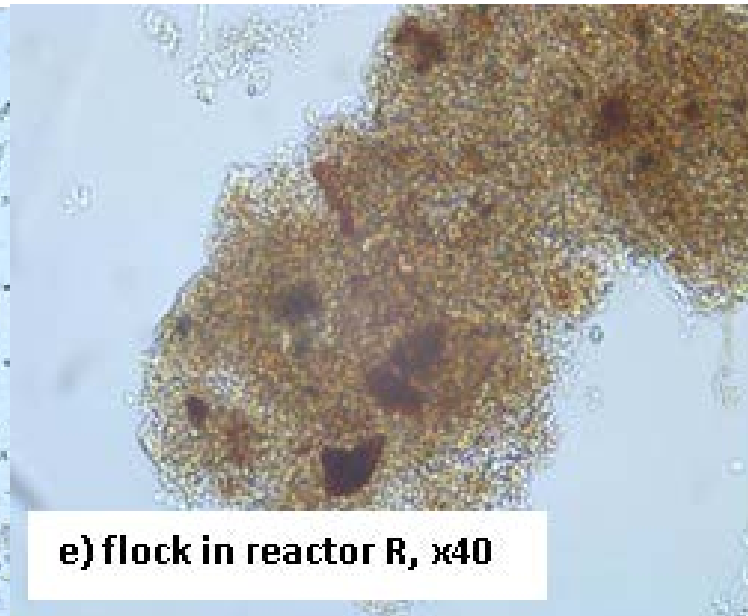
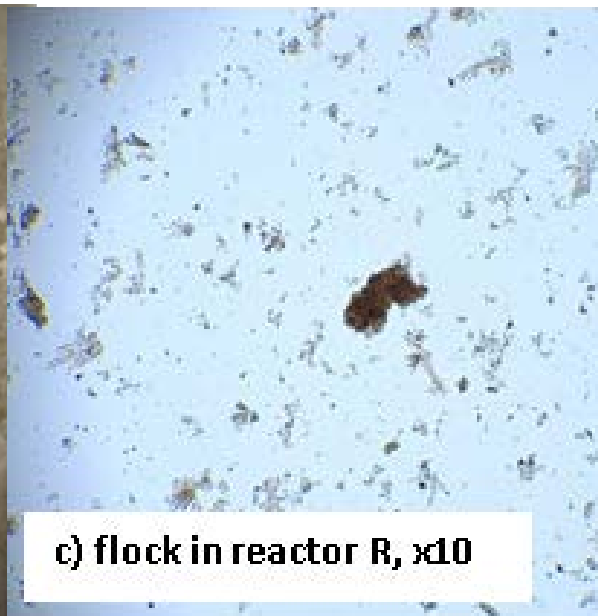
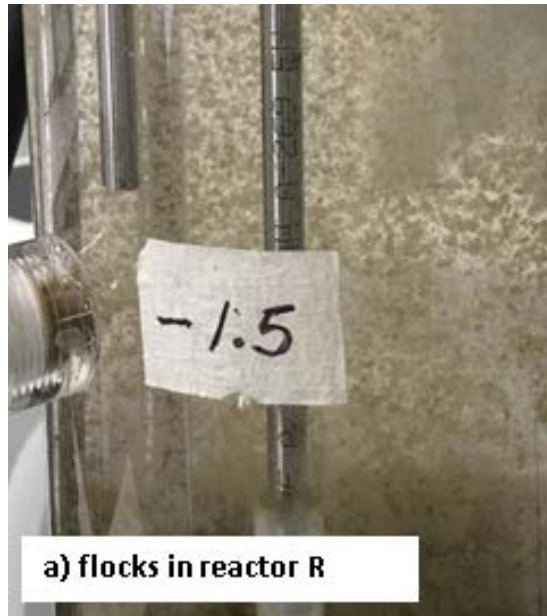


Further evidence of successful anammox enrichment

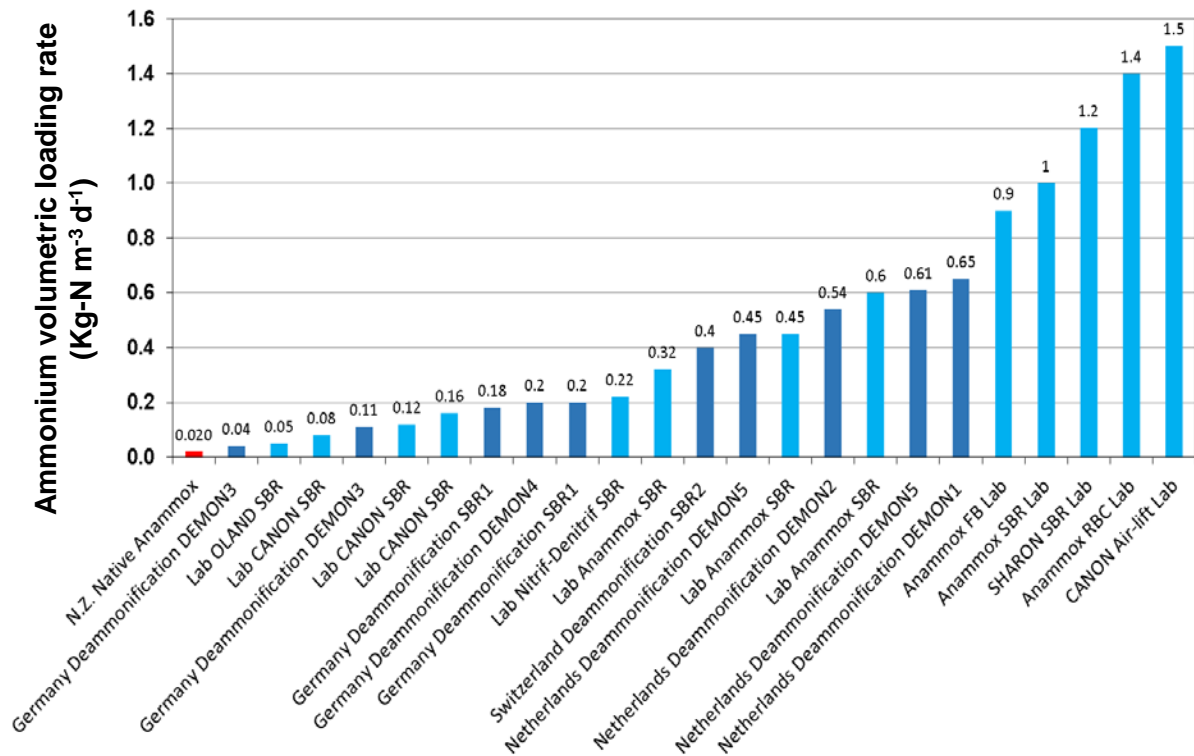
- ✓ Increasing anammox genes
- ✓ Increasing activity rates
- ✓ Nitrogen gas production
- ✓ By-product (NO_3^-) formation



2. ENRICHMENT



3. SCALE-UP

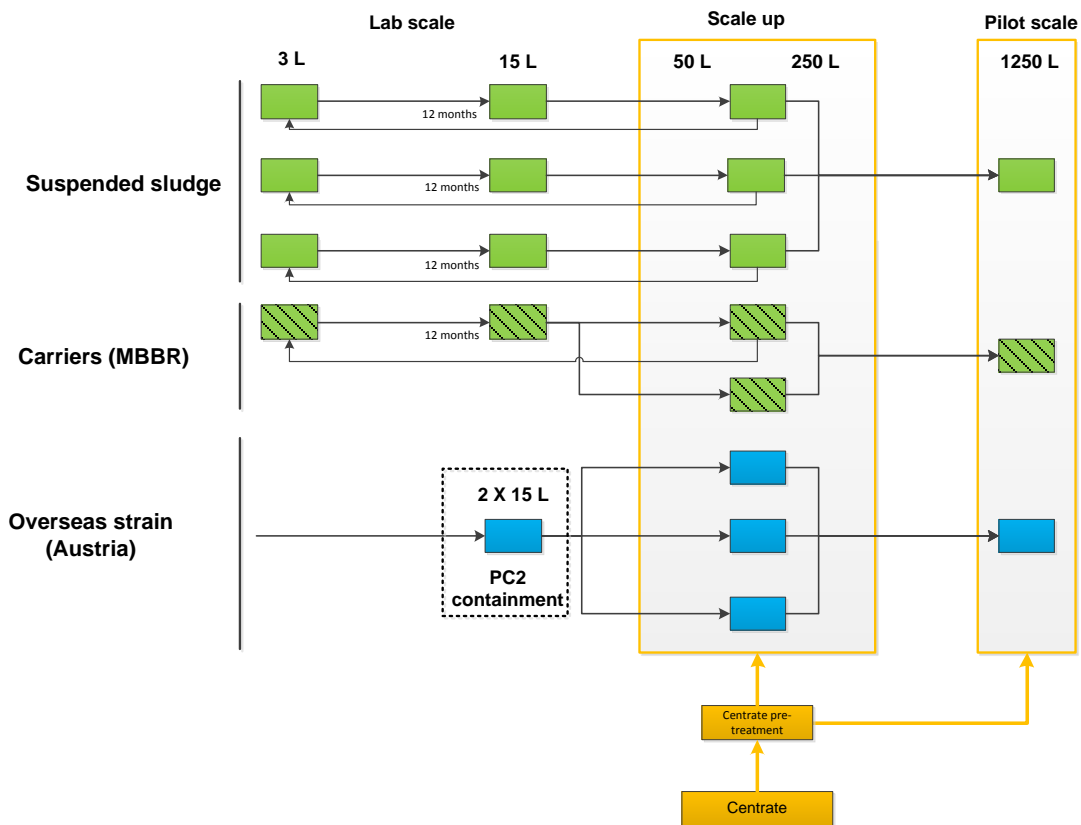


Anammox based BNR systems

Humbly, but putting New Zealand back on the map

(Third et al, 2005. Microbial Ecol 49:236-244;
Lackner et al, 2015. Water Research 55, 292-303)

3. SCALE-UP



Scale-up strategy
On-going work.

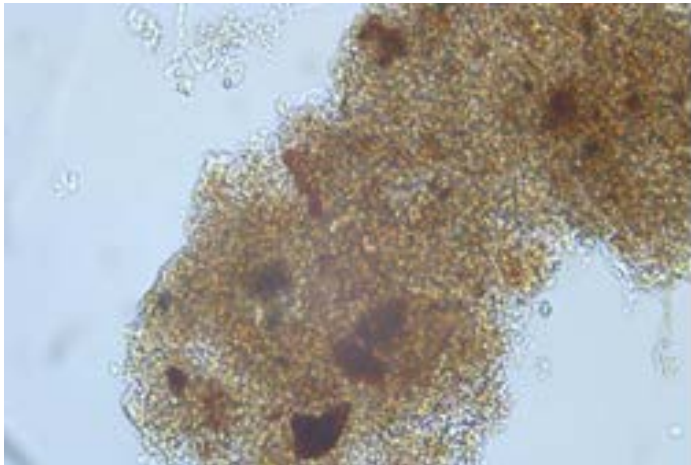


PROMISING FOUNDATIONS



- We now have cultures which will be used to seed larger reactors
- We developed a method to enrich anammox bugs which has resulted in valuable knowledge and potential Intellectual Property
- We have built an on-site Wastewater Innovation Centre, available to do pilot trials

SUMMARY



- It has been a very valuable and challenging journey
- Anammox based BNR technology is now reachable in N.Z.
- On target to achieve Energy Neutrality by 2025
- Our operations and partnerships will intensify to really reach this goal



Thanks

