Bioenergy from waste through Microbial Fuel Cells – practical implementation for scaled up systems

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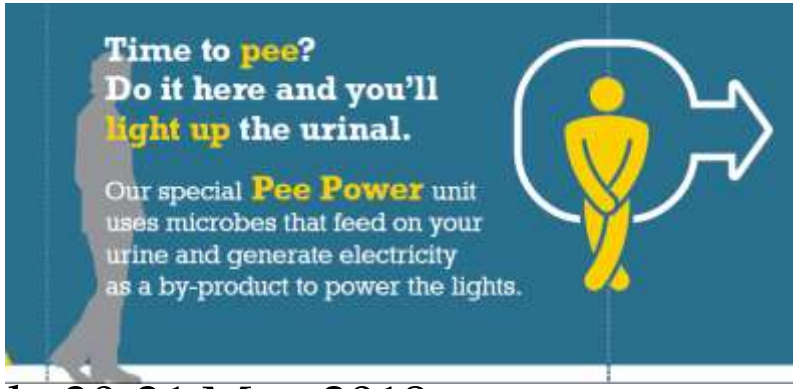
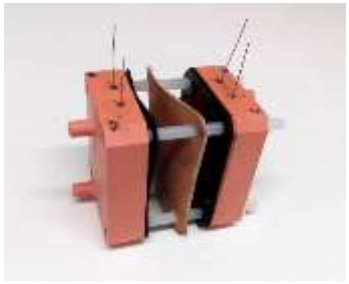
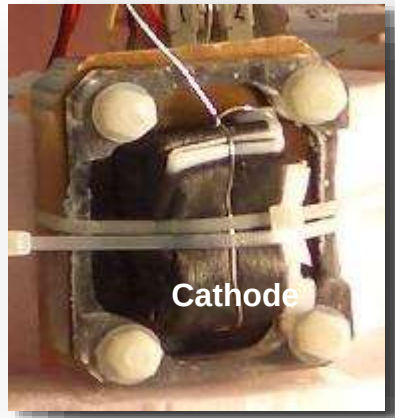
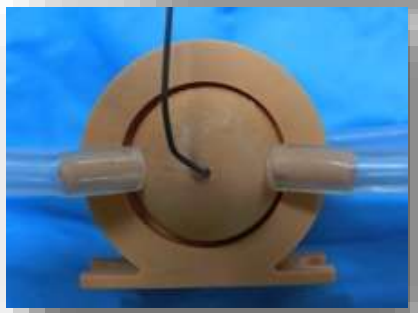


Bio Electrical Engineering Workshop, University of Warwick, 30-31 May 2018

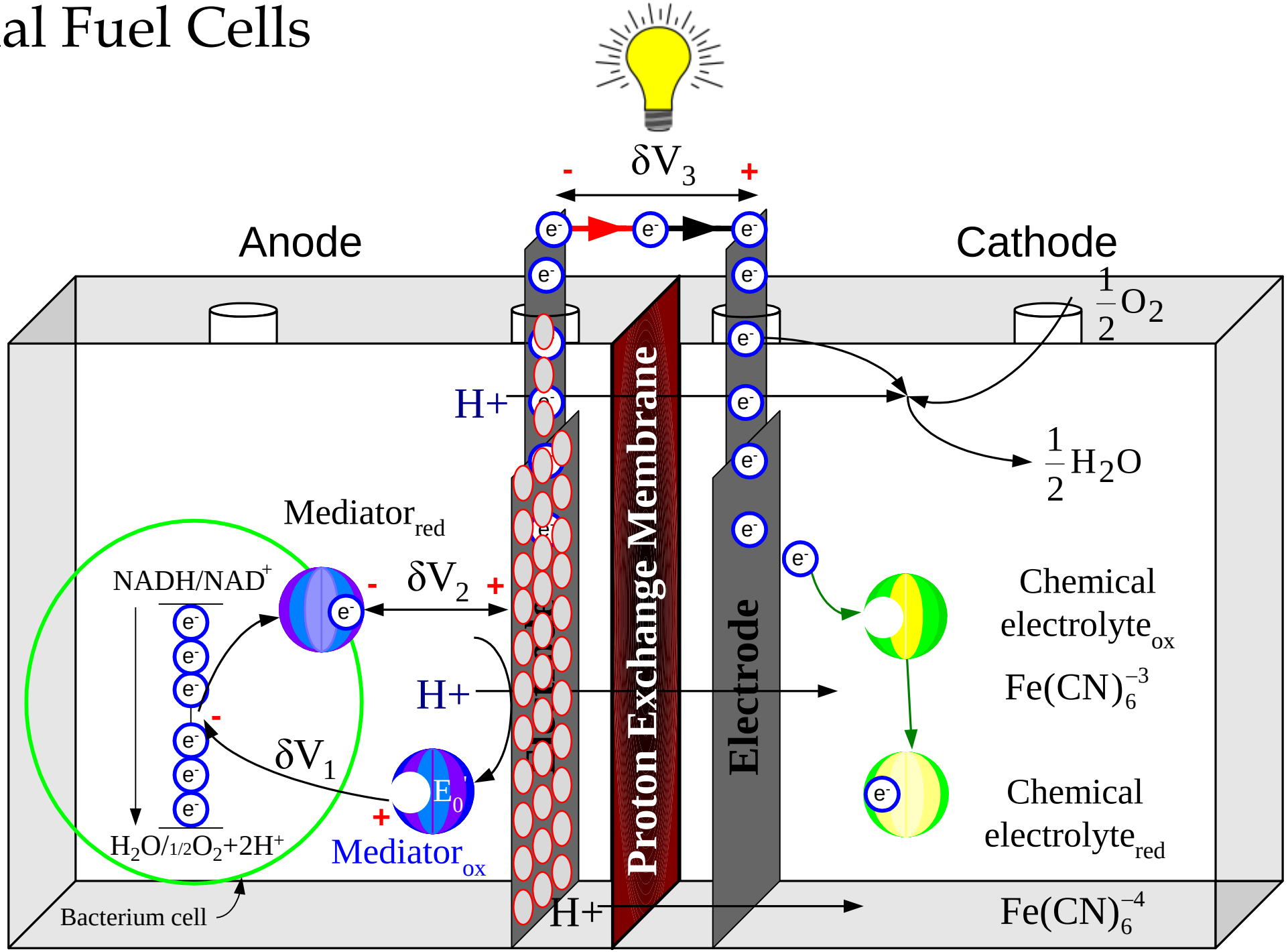
Microbial Fuel Cells



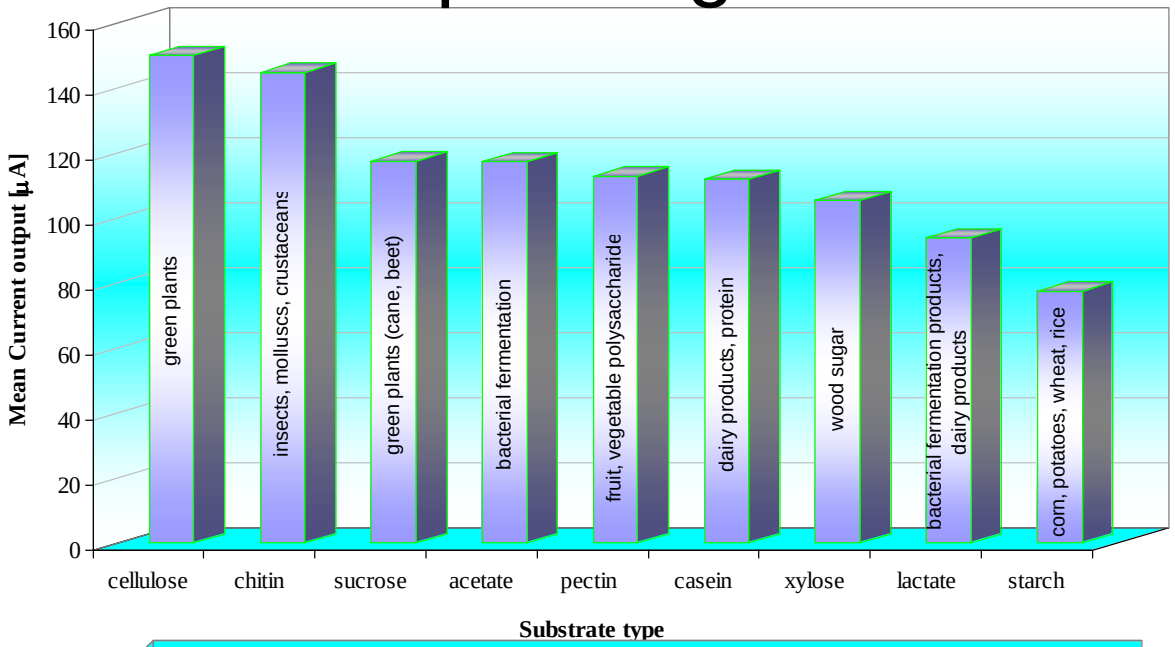


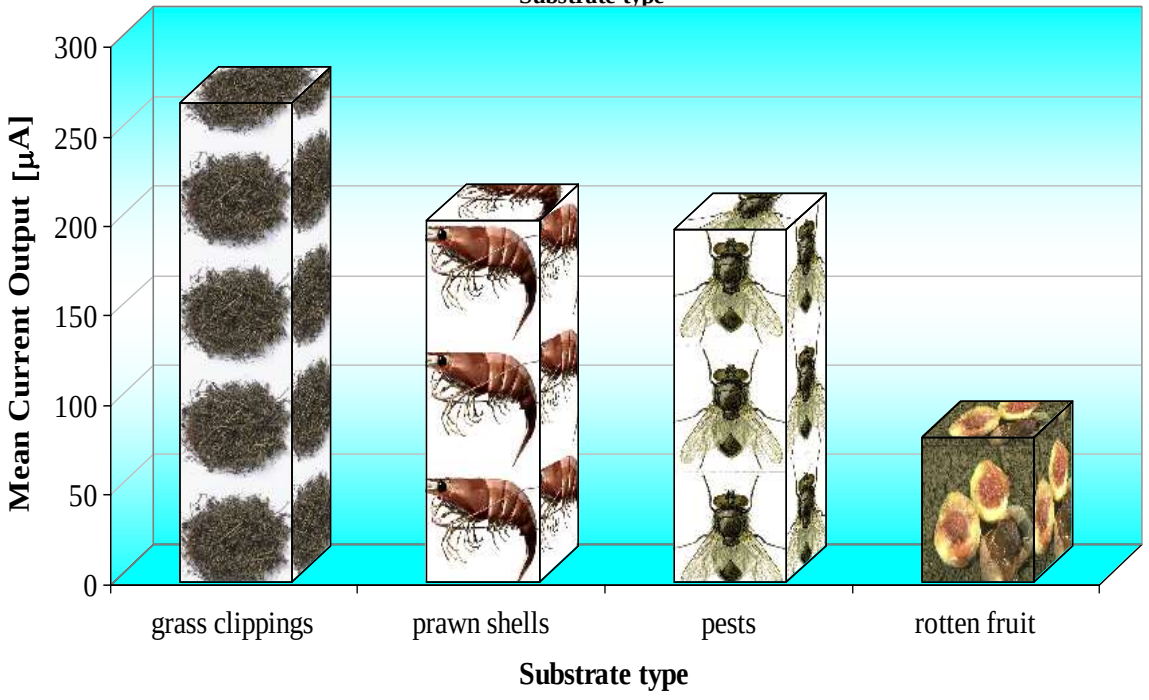


Microbial Fuel Cells



Feedstock profiling



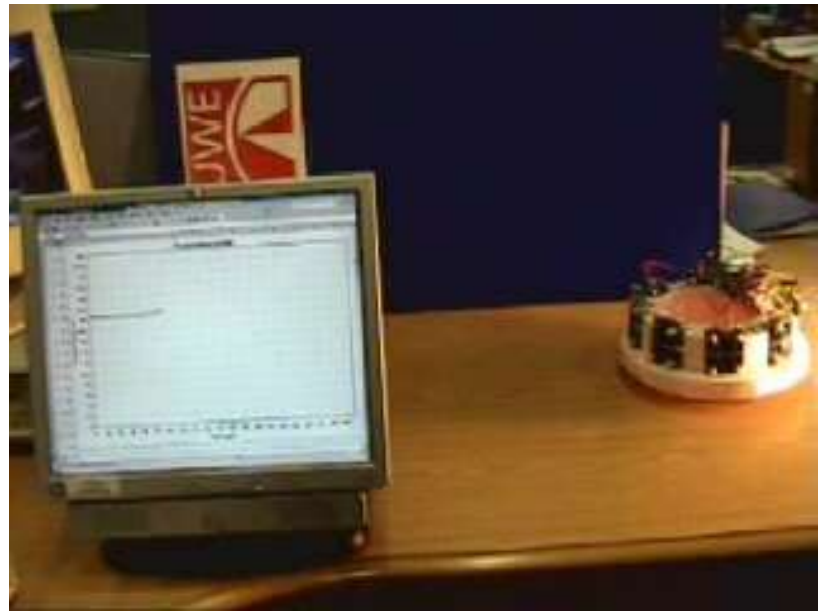


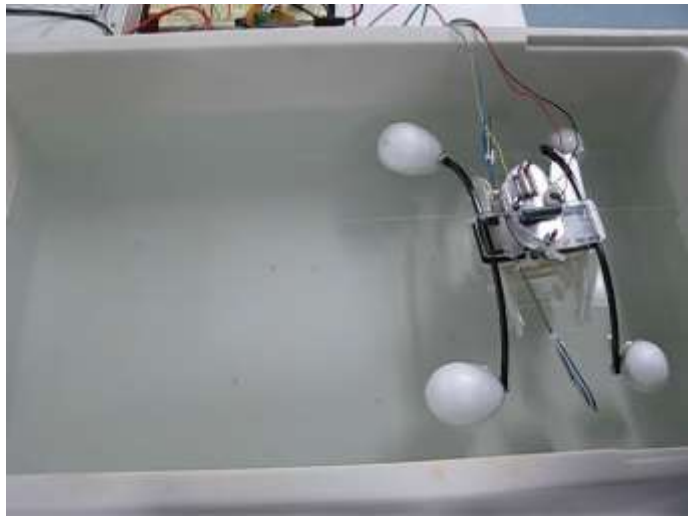
Insect digestion monitoring

Autonomous robots: EcoBots and Row–Bot

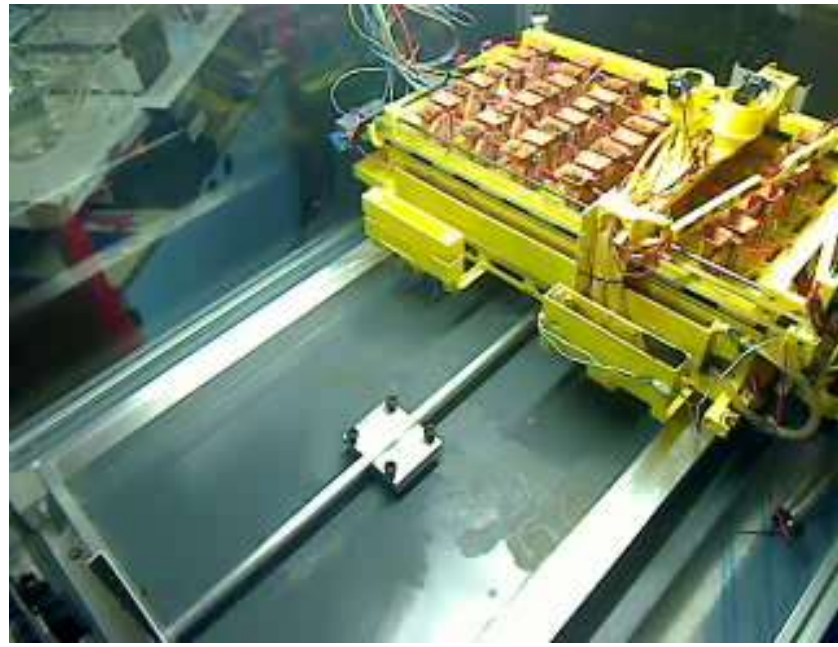
EcoBot-I
2003

EcoBot-II
2005





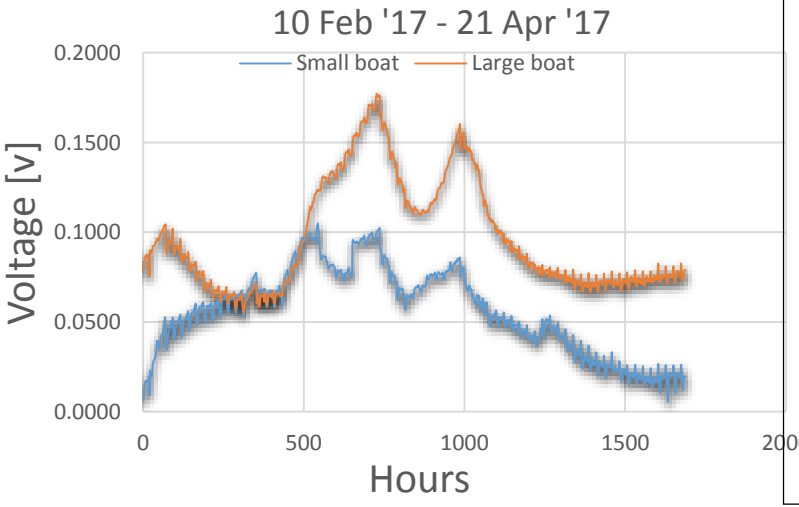
Row-Bot, 2015



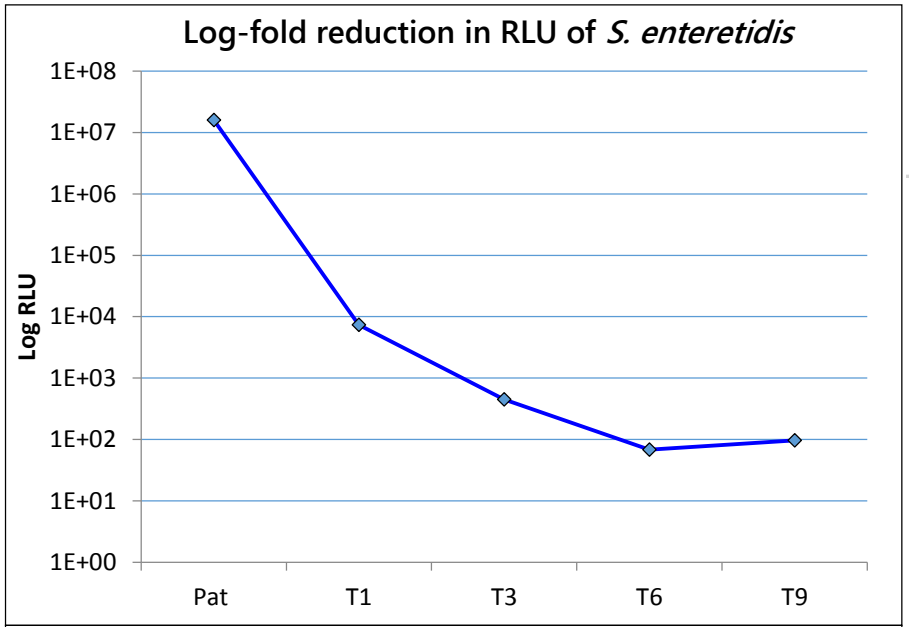
EcoBot-III
2010

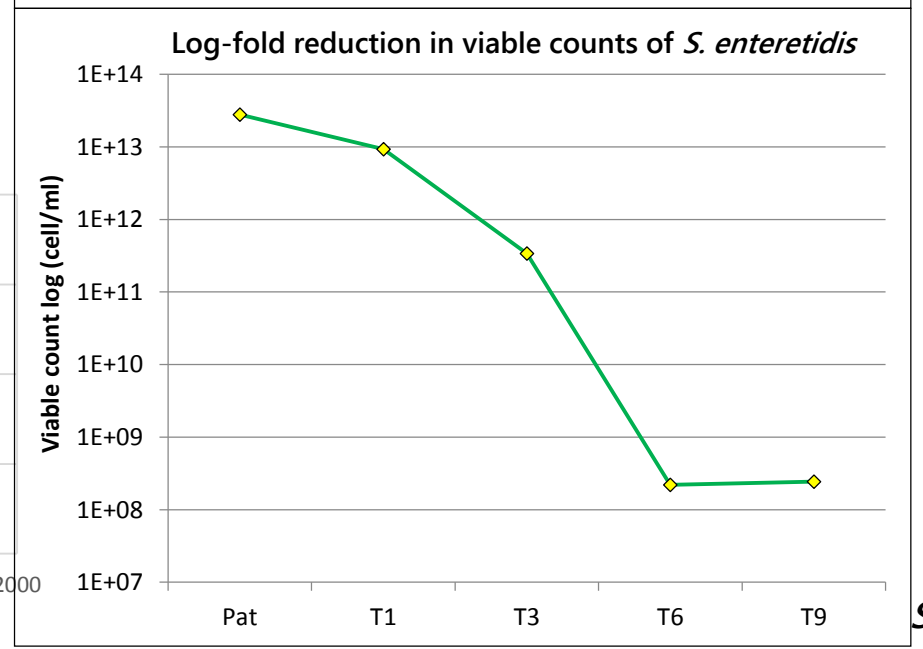
EcoBot-IV
ongoing

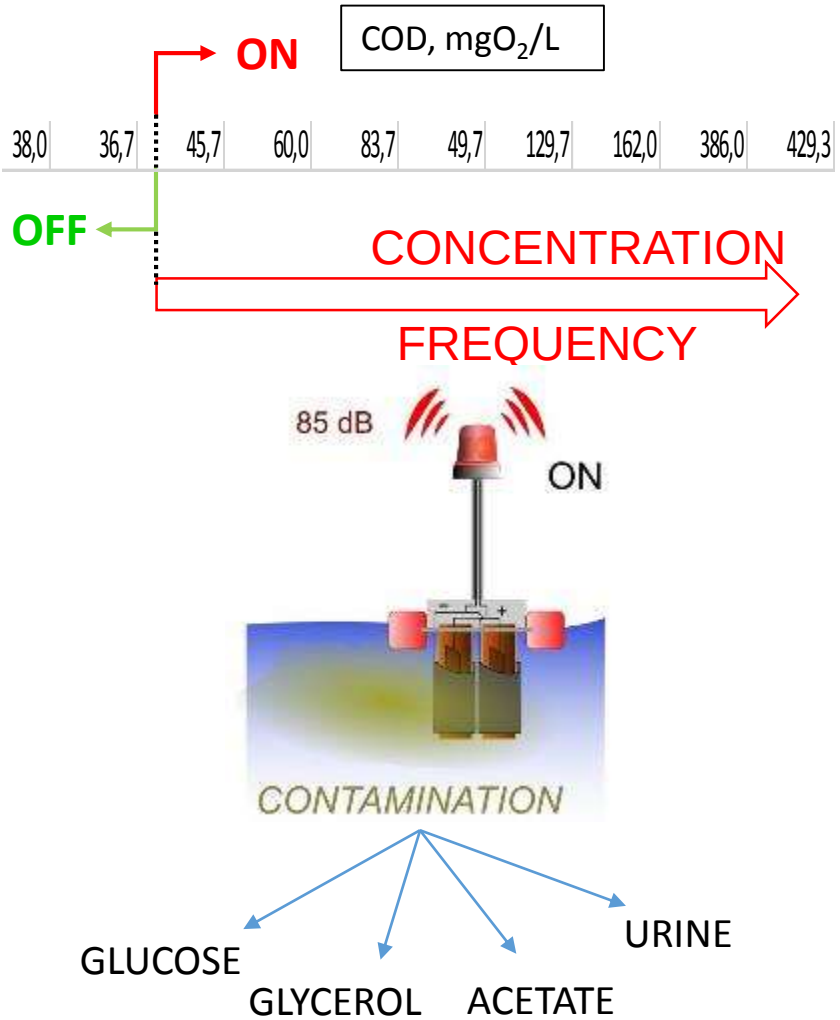
Platform technology: (i) pilot testing, (ii) pathogen killing, (iii) biosensing



PloS ONE 12 (5), e0176475





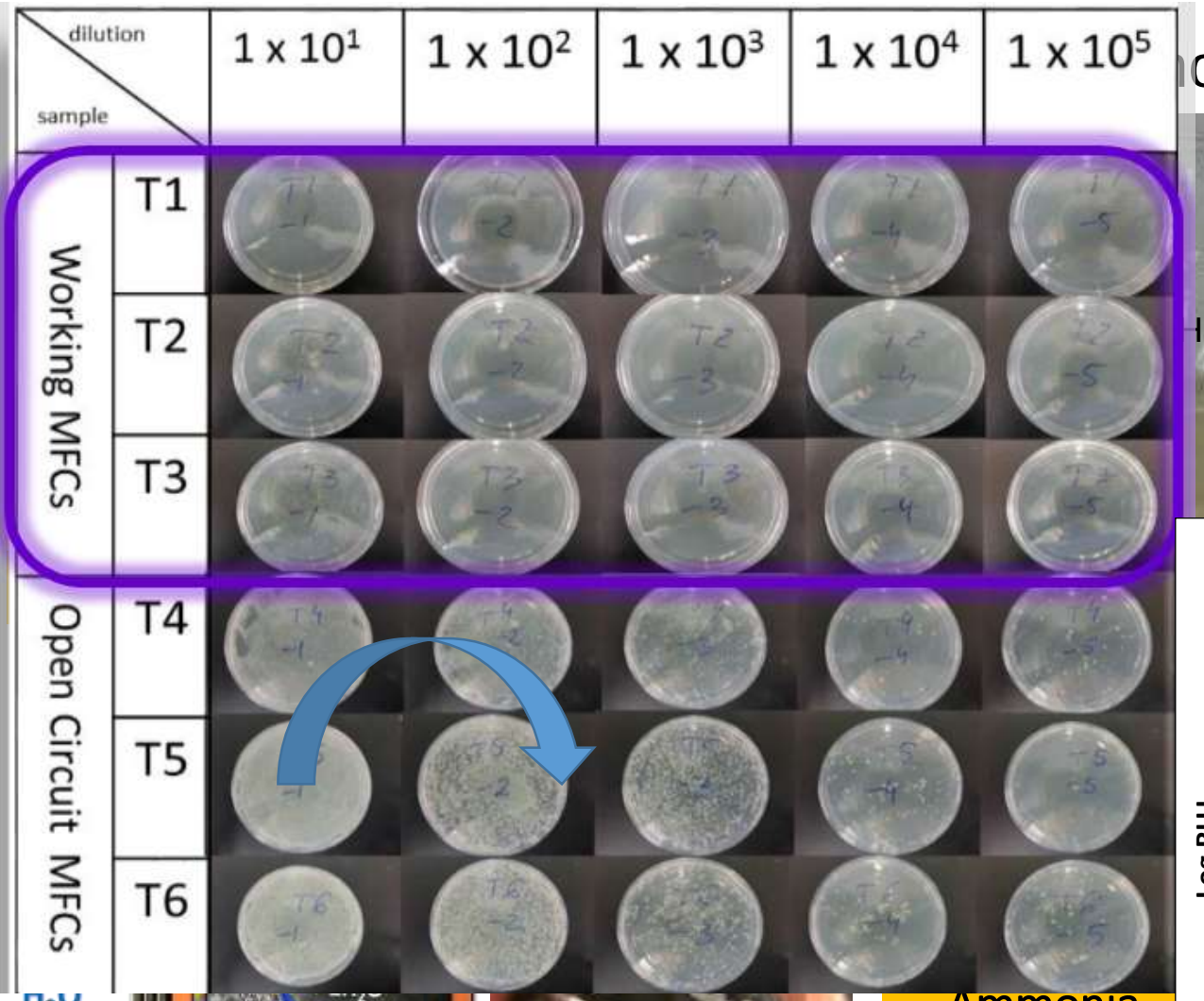


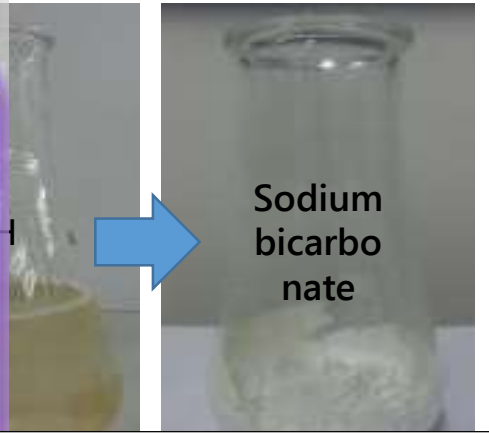
250 DAYS OF CONTINUOUS OPERATION

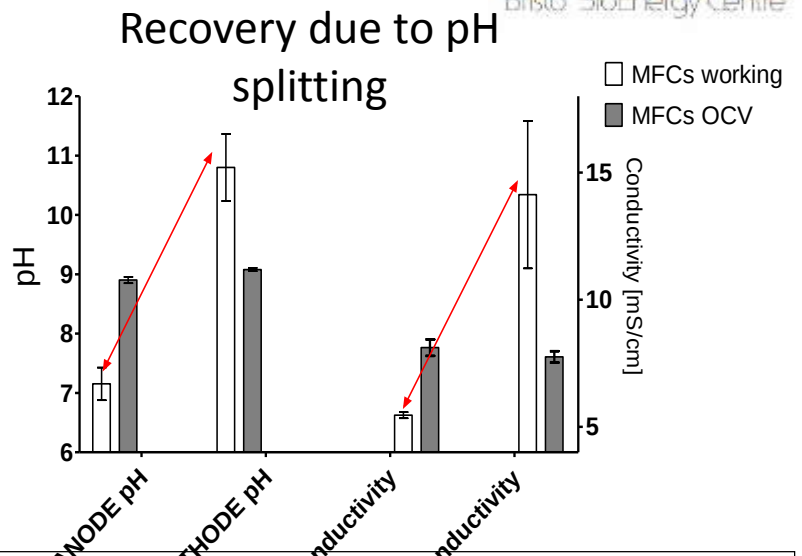
Sensors and Actuators B: Chemical 244, 815-822

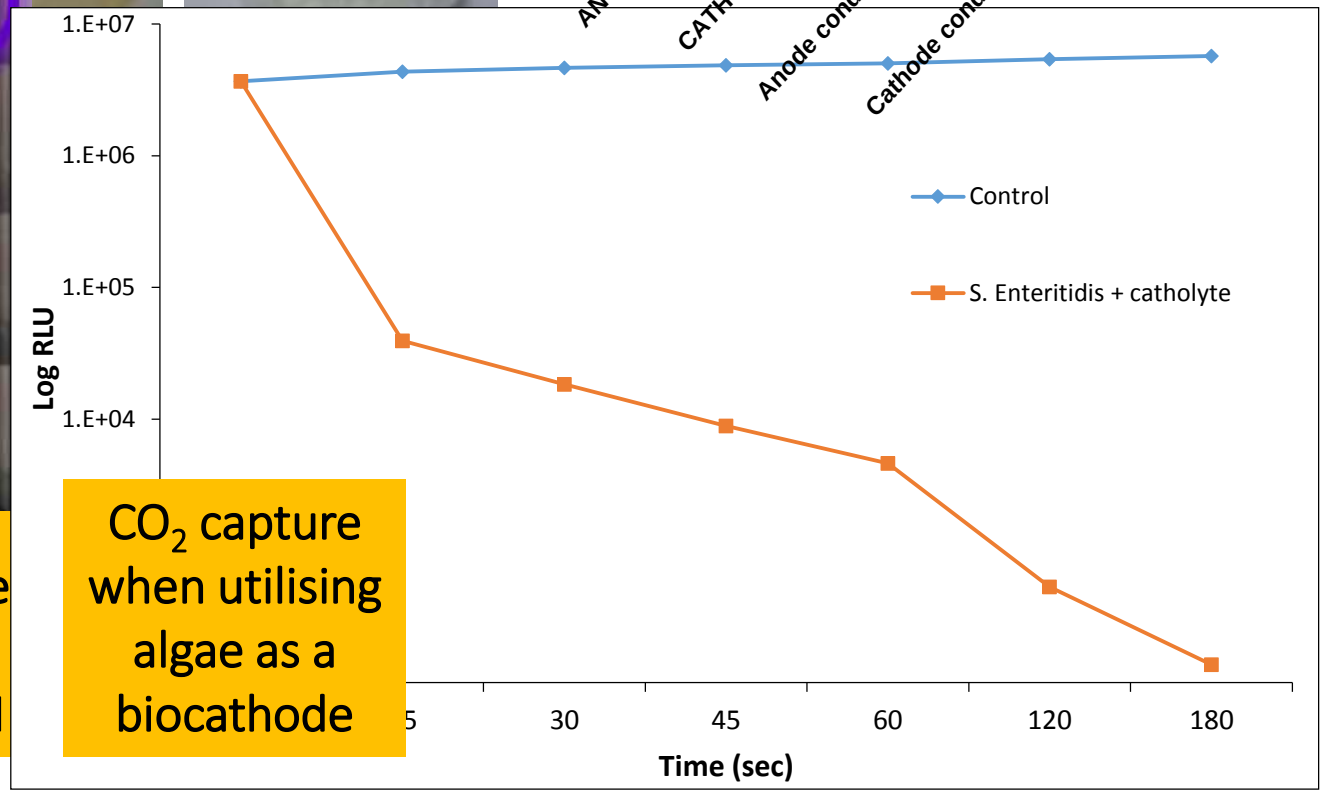
Platform technology: (iv) disinfectant production

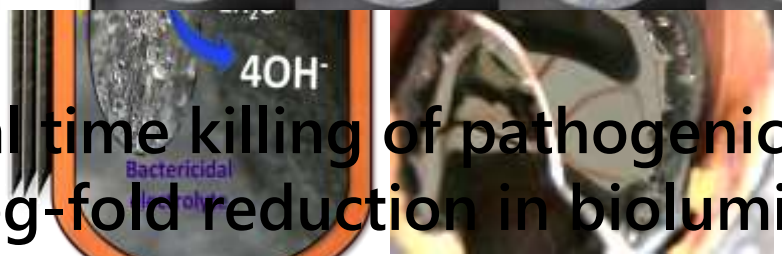
olyte









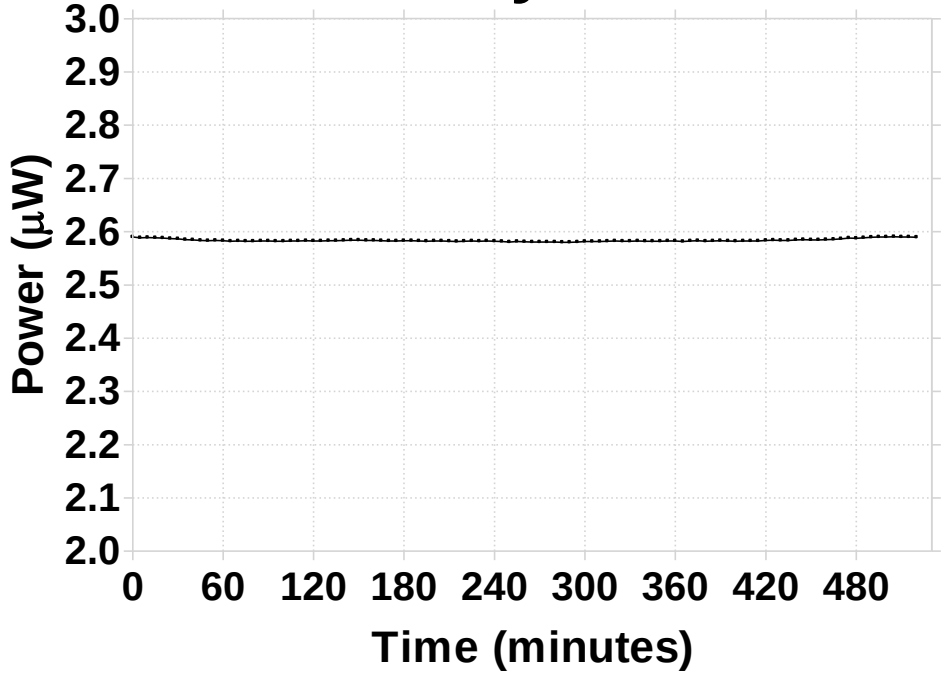


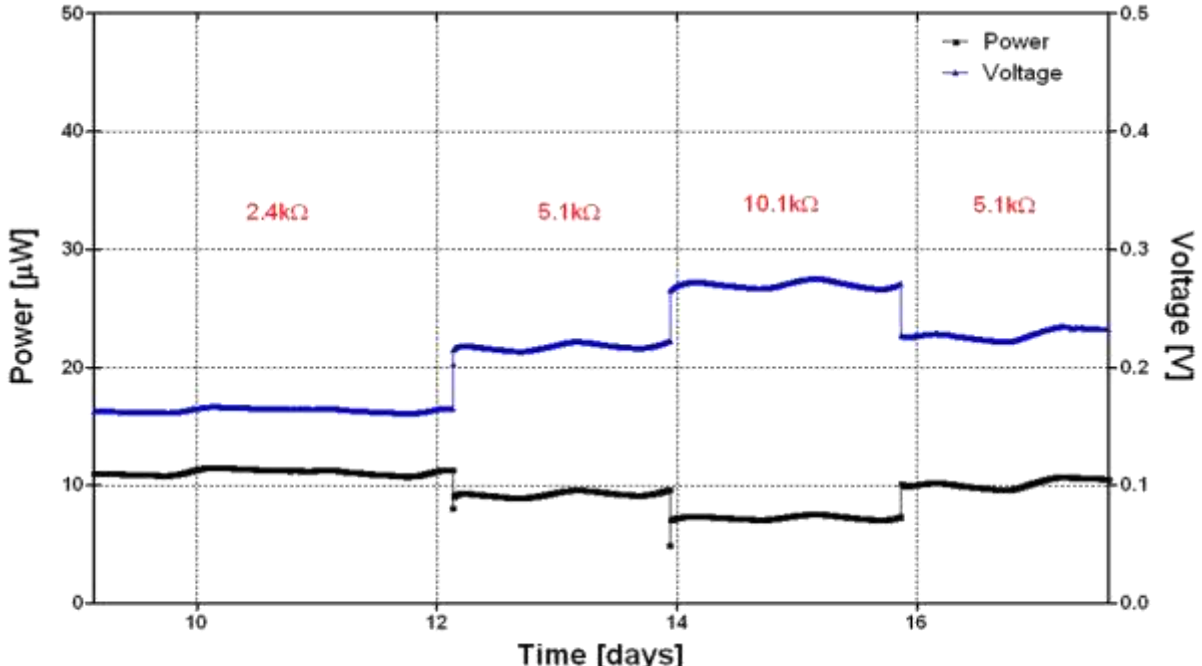
Real time killing of pathogenic organisms log-fold reduction in bioluminescence

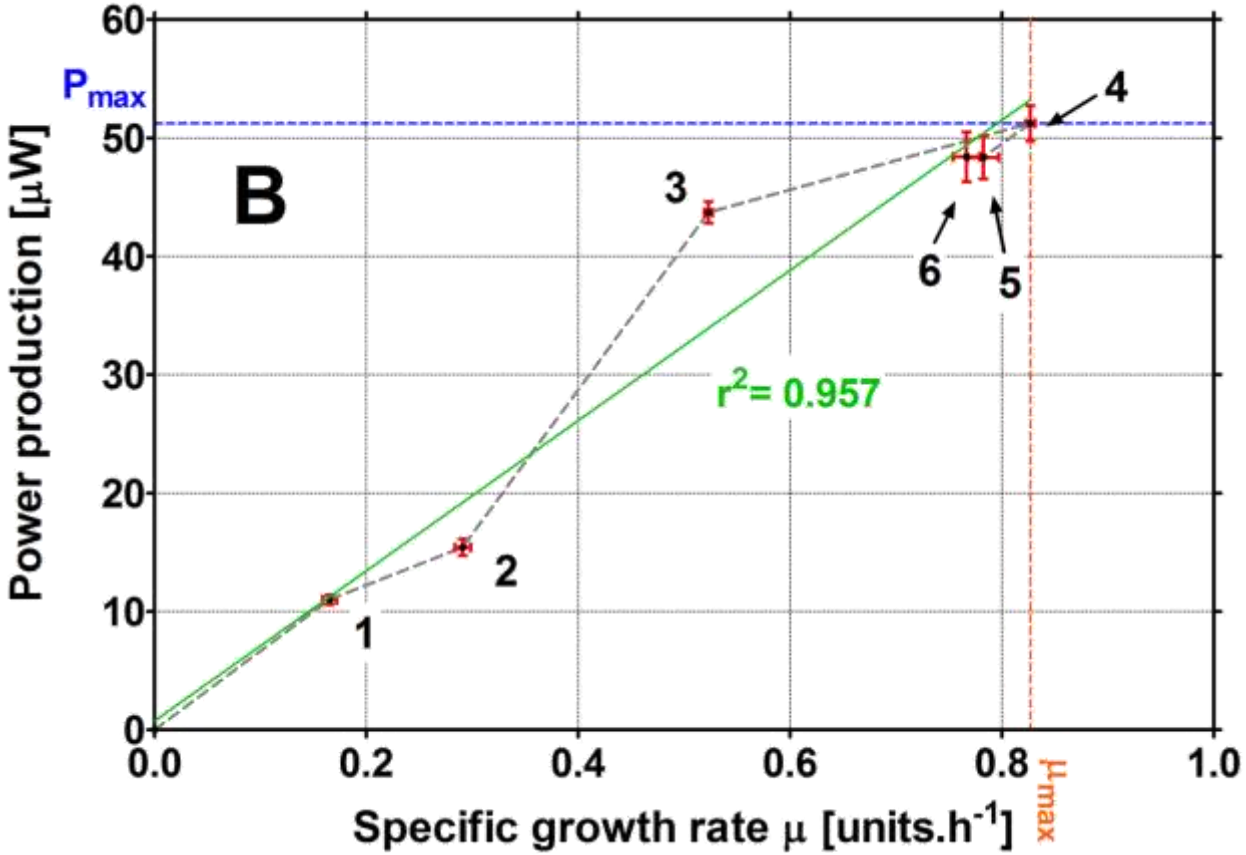
Ammonia stripping due to increased catholyte pH

CO_2 capture when utilising algae as a biocathode

Biofilm stability: behaviour studied through MFCs

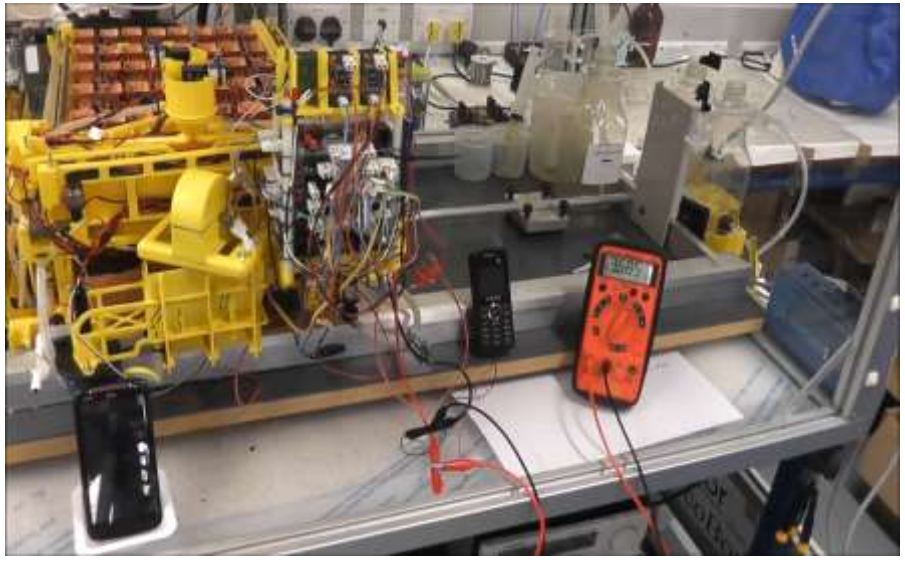






Bioresource technology, 118:615–618, 2012

Mobile phones, wearables & Pee Power® urinals power improvement



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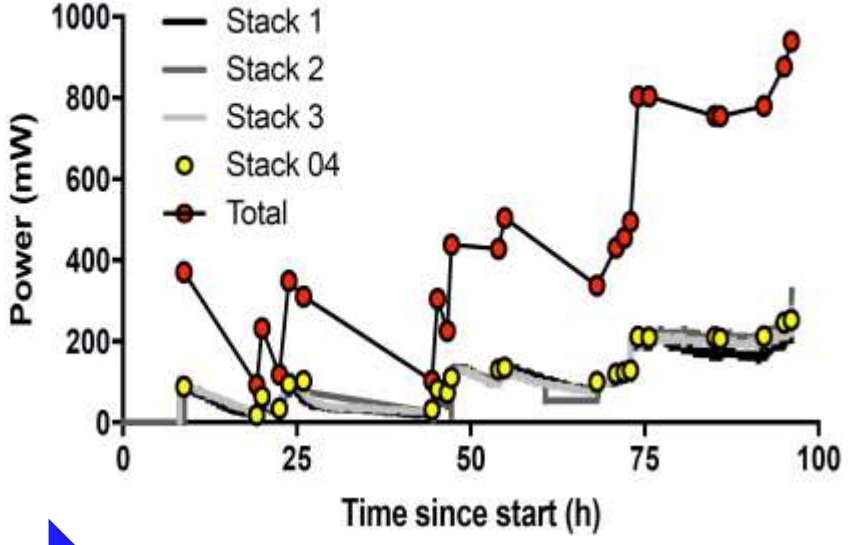
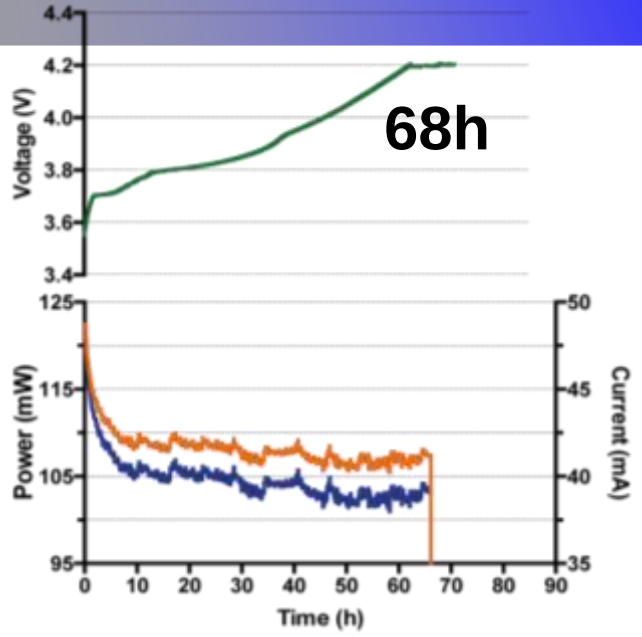


From *mW*

To *Watts*



PeePower® urinal – Glastonbury festival

2015

2015

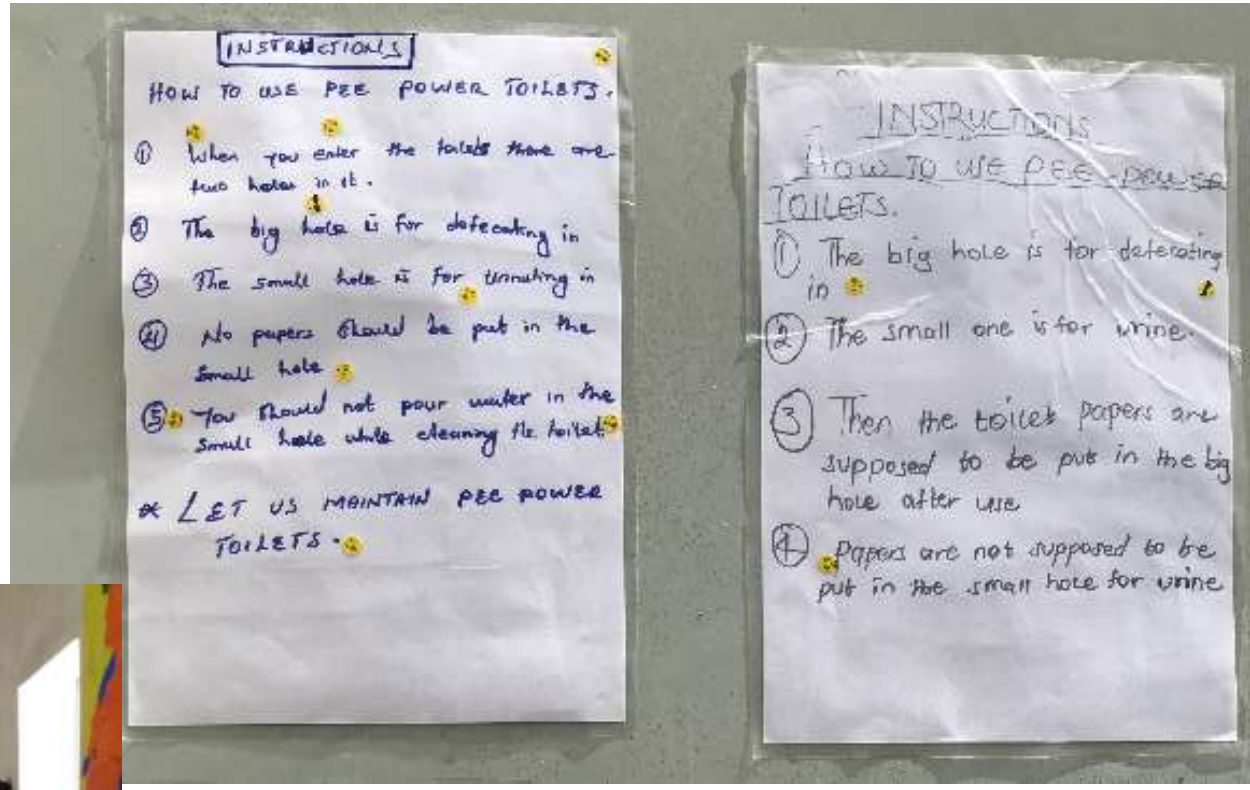
2016

2017

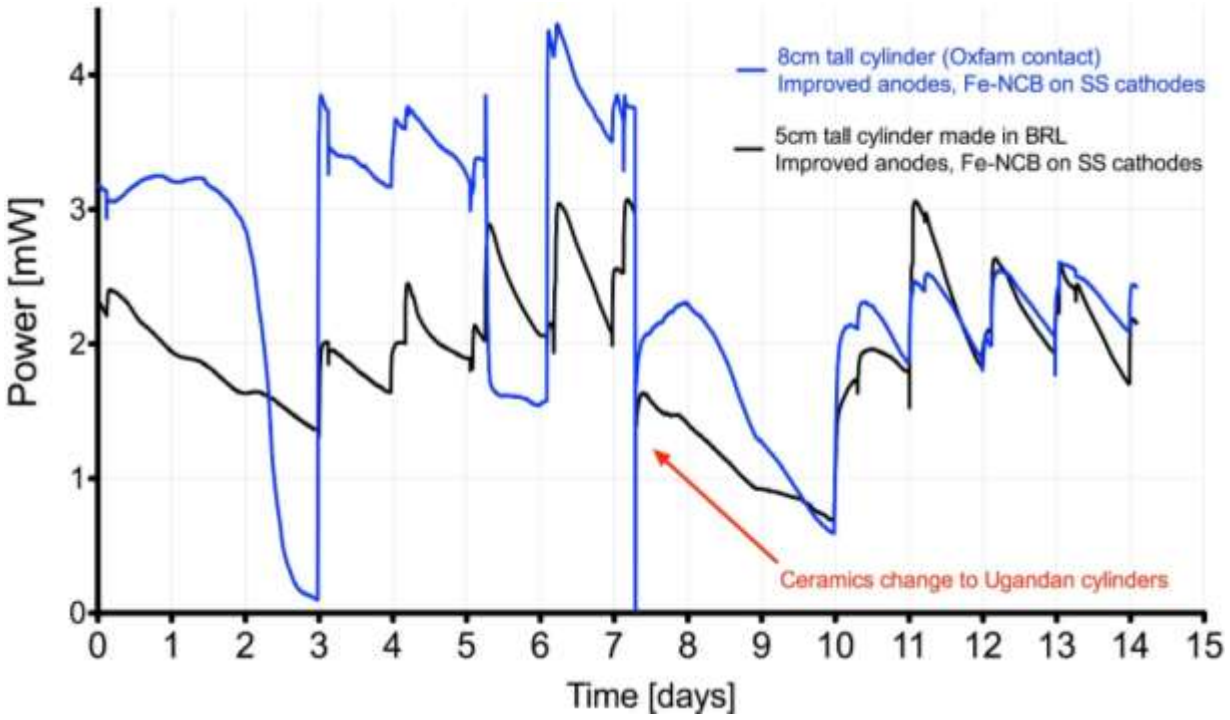
The PEE POWER® urinal was fiel-trialled at the 2015, 2016 and 2017 Glastonbury music festival, with ~ 1000 people using it per day (≡ 500L·urine/day).

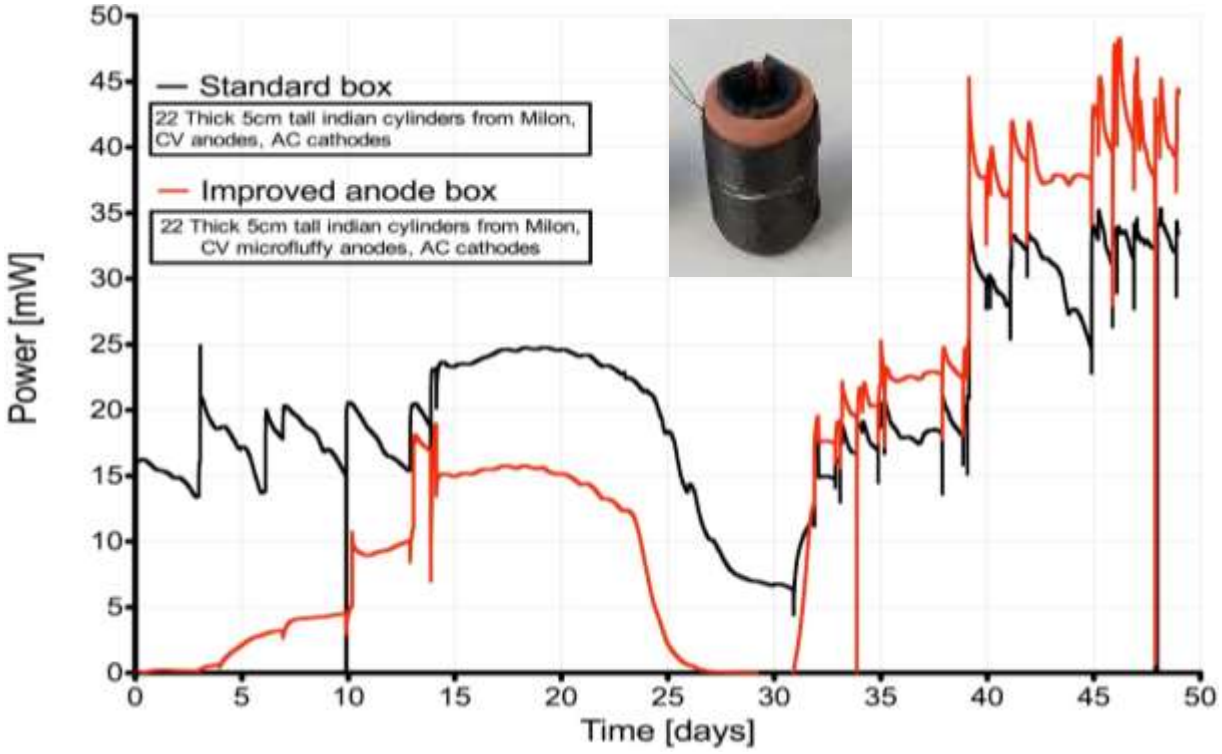
First overseas Pee Power® field trial: Seseme Girls' Boarding School, Kisoro, Uganda

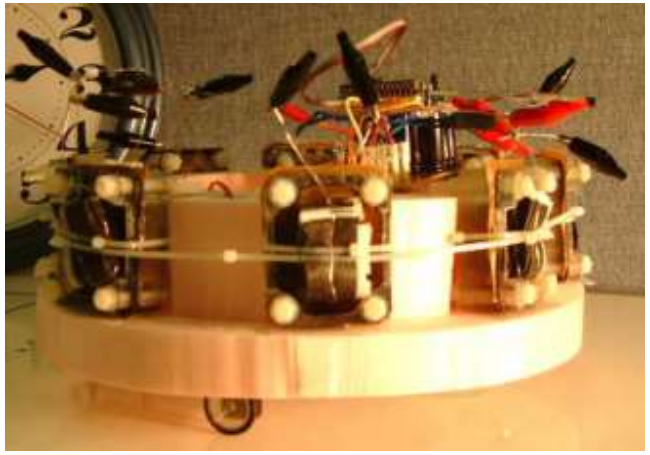
First overseas field trial: Seseme Girls' School

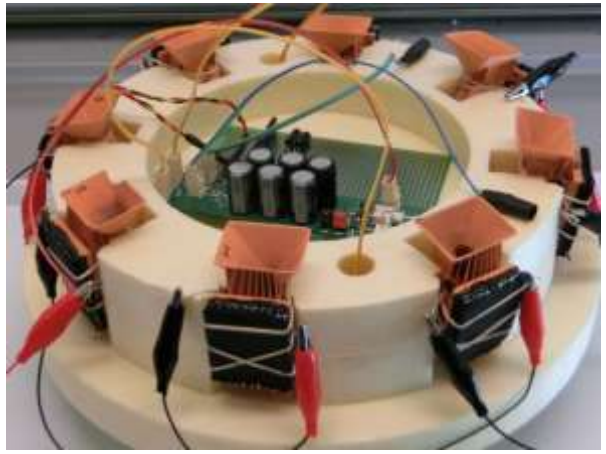


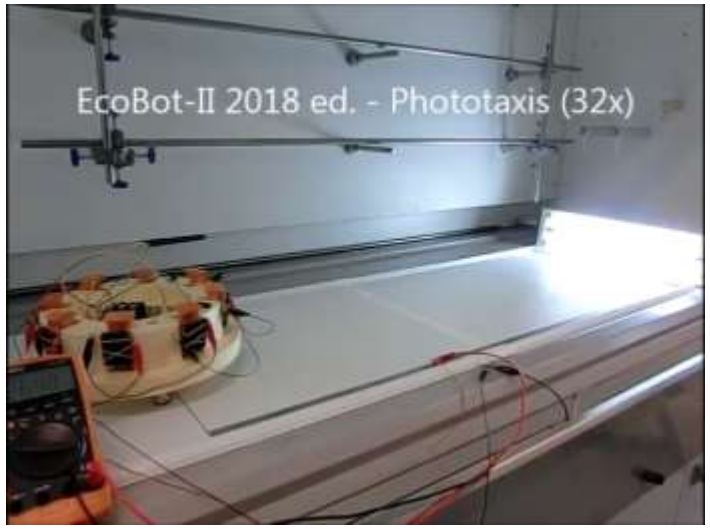
Continuous development – most recent findings











Discussion: Challenges/Opportunities

- Small scale MFCs exhibit higher energy density; how small can we go in different environments (333A/m^3 from 24x130µL)
- Resource recovery through different materials; which material for which reaction or elements
- Bacterial community analysis; evolution and adaptation from inoculation to maturing for both mono- and mixed-cultures
- Ceramic appears to be ideal for energy + treatment + resource recovery; more information and access to full range of materials is needed
- Chemical energy accumulation can occur by simply controlling external conditions; how does this get built-into a system; electrode modification (e.g. FeAAPyr, UNM)
- Pathogens can be eliminated through normal MFC operation or through controlling physico-chemical conditions; this requires systems engineering
- Depolymerisation of macro-molecules found in blackwater and also the lytic efficacy of the synthesized catholyte on a range of faecal parasites

Acknowledgments

BBiC Bristol BioEnergy Centre

EPSRC
Engineering and Physical Sciences Research Council

Horizon 2020 European Union Funding for Research & Innovation

BILL & MELINDA GATES foundation

The Thriplow Trust

SEVENTH FRAMEWORK PROGRAMME

EXPLORA BIOTECH pioneering nature

OXFAM

Roca

LIQUIFER SYSTEMS GROUP

Newcastle University

CogSys
Cognitive Systems

GREAT WESTERN RESEARCH

Innovate UK
Technology Strategy Board

CSIC CIB

CIBIO

RSE Ricerca Sistema Energetico

Information Society

Wessex Water
a YTL company

THE BIOROBOTICS INSTITUTE
Scuola Superiore Sant'Anna

CALIFORNIA INSTITUTE OF TECHNOLOGY 1891

MÉXICO
GOBIERNO DE LA REPÚBLICA

CONACYT
Consejo Nacional de Ciencia y Tecnología

THE UNIVERSITY of NEW MEXICO
New Mexico's Flagship University

AQUAM

The Leverhulme Trust