

# Electrochemically enhanced bioremediation of groundwater

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# Bioremediation

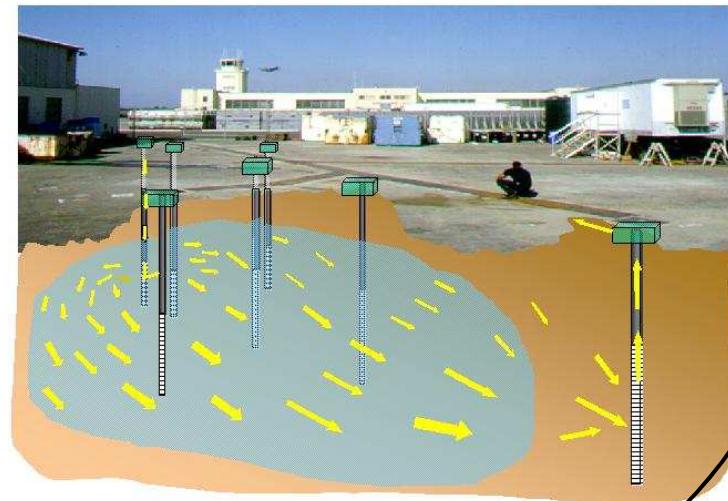
- the use of microbial metabolism to remove pollutants

## EX SITU



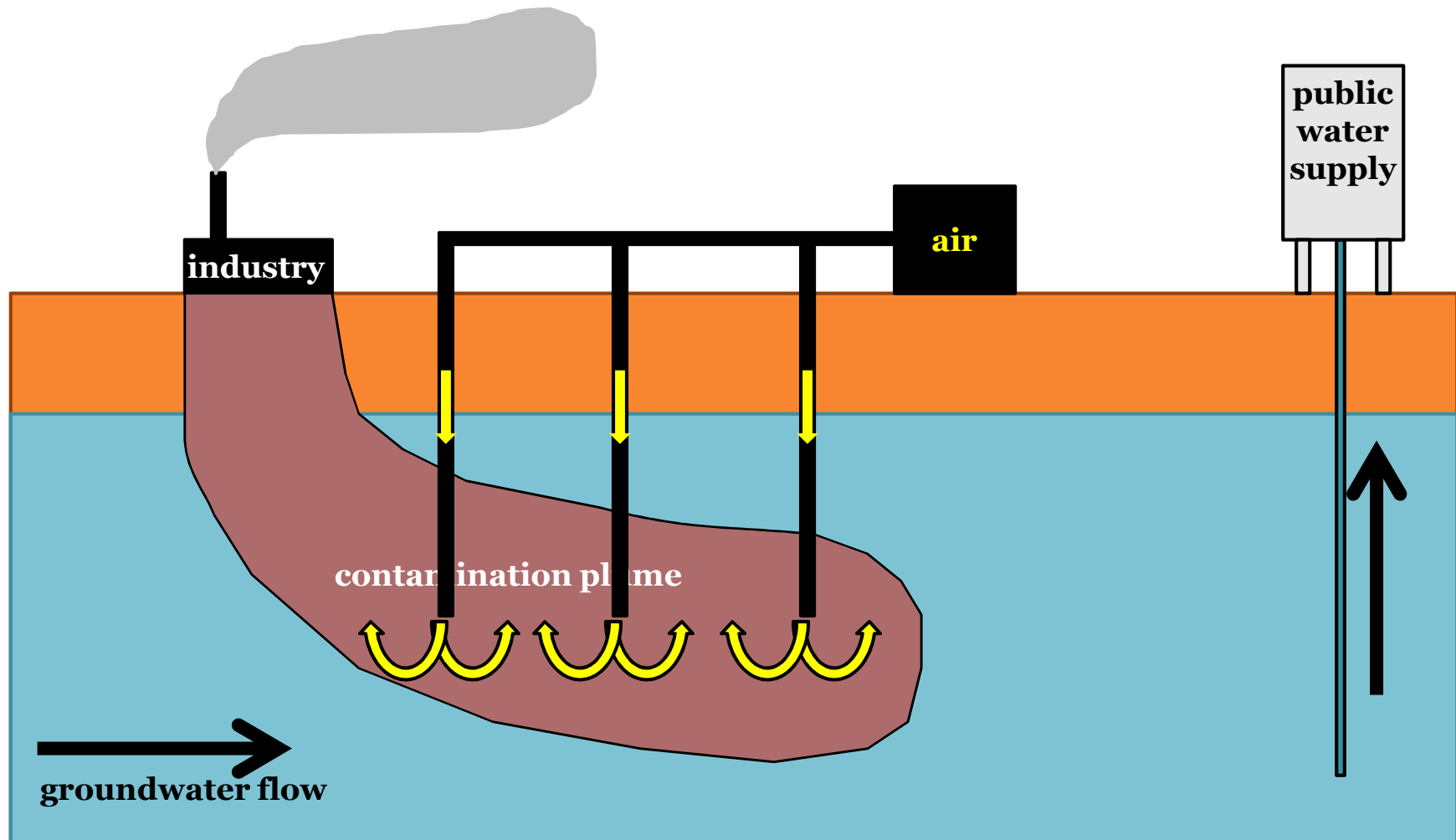
<http://ndep.nv.gov/bca/perchlorate05.htm>

## IN SITU



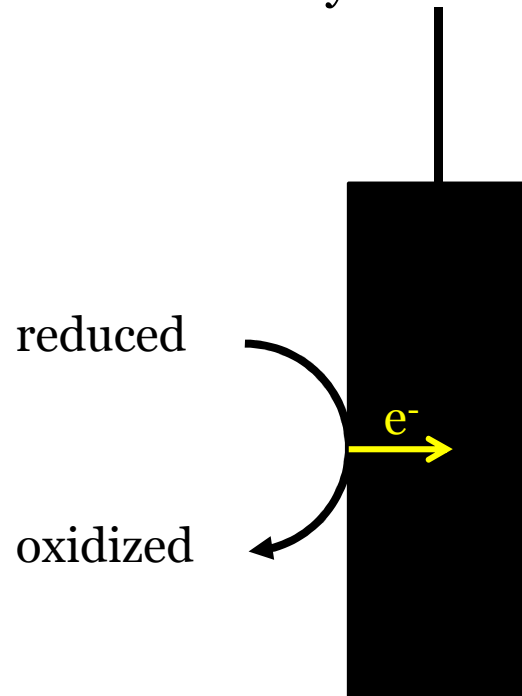
<http://bioprocess.pnnl.gov>

# Bioremediation enhancement

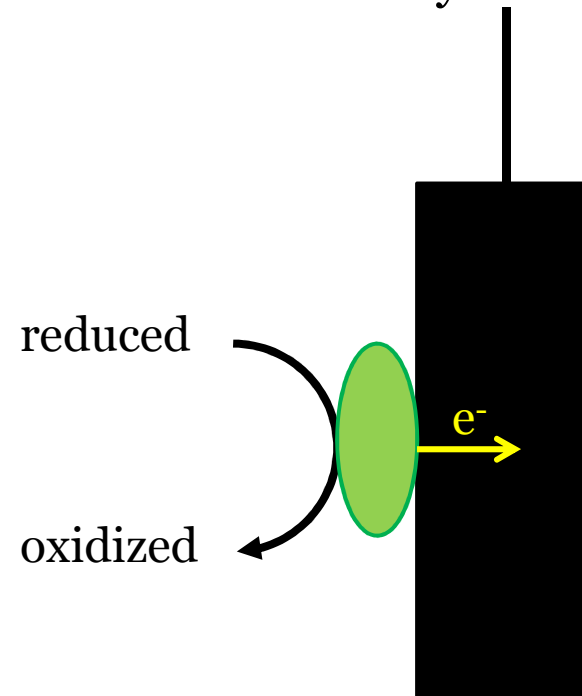


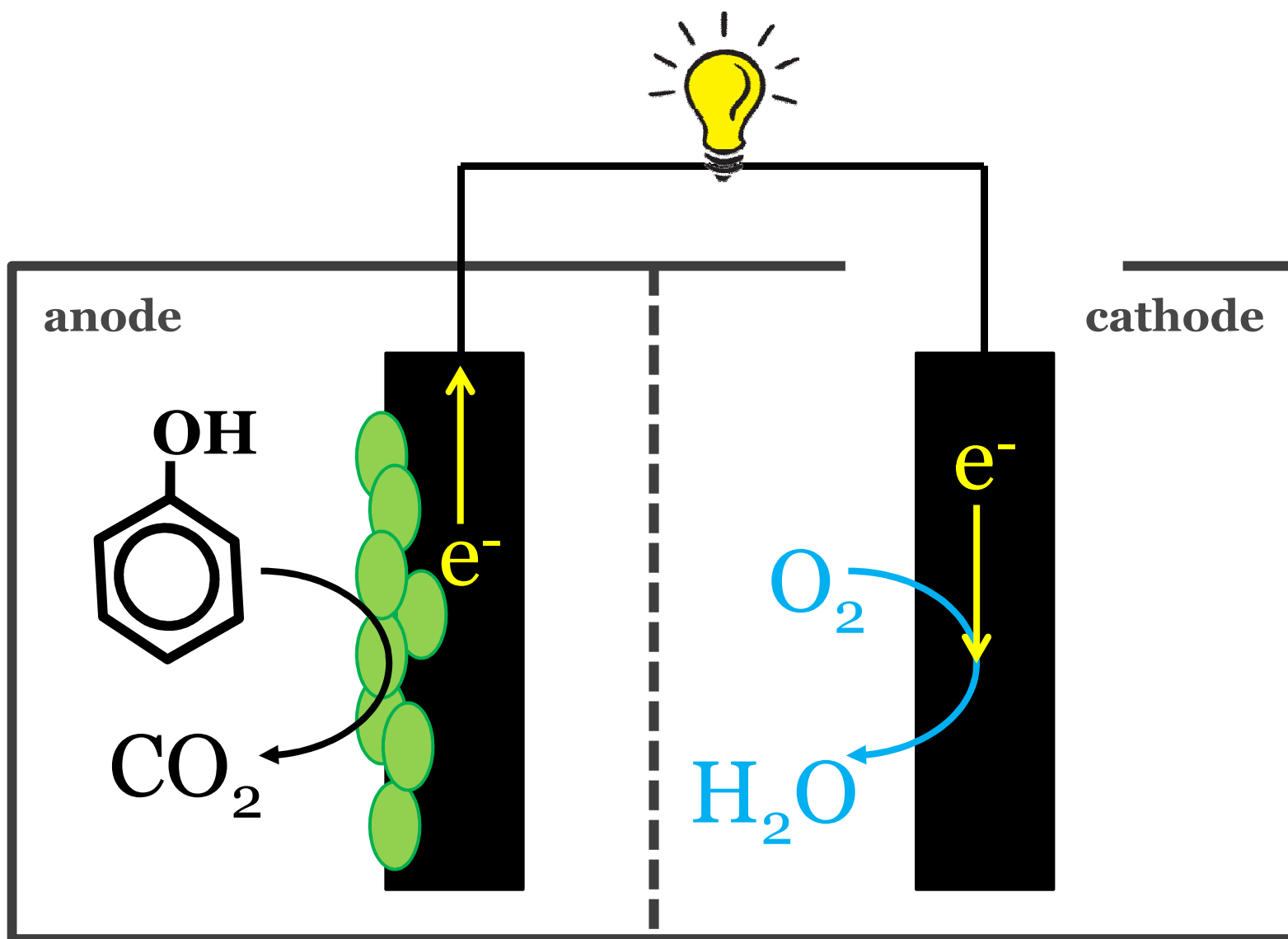
# Electrochemically enhanced...

- Electrochemistry

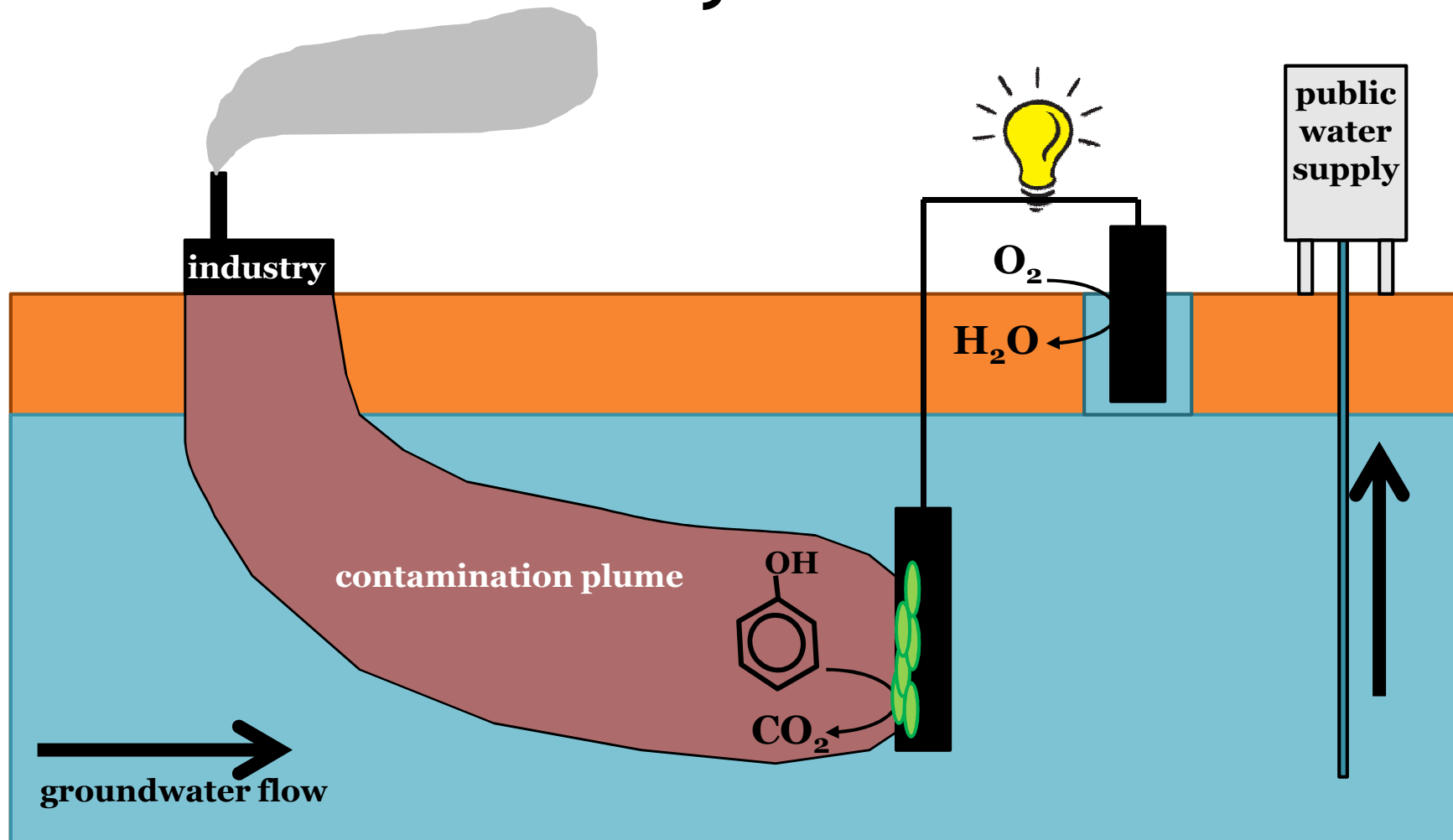


- Bio-electrochemistry

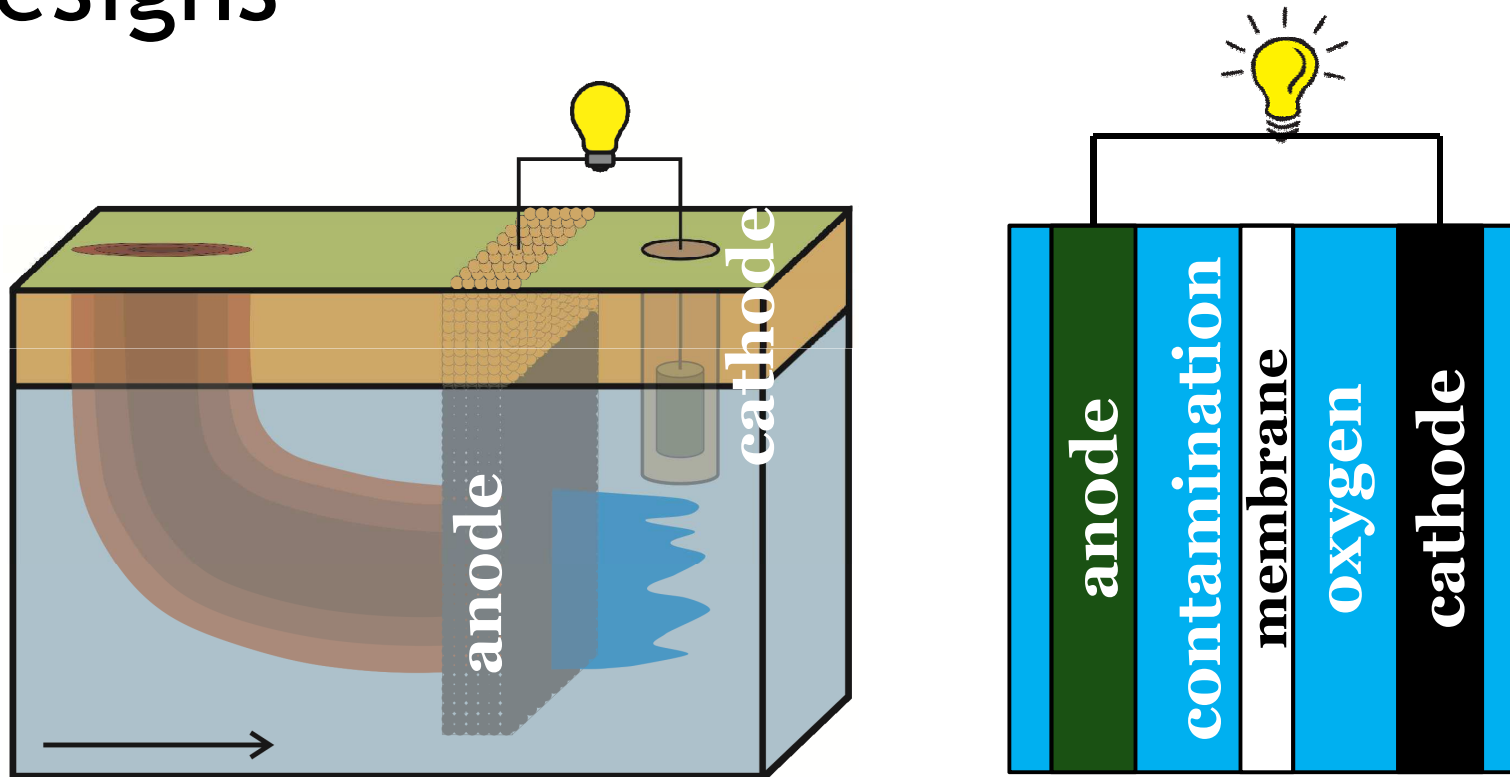




# Electrochemically enhanced...



# Designs



Review paper (in prep.): Hedbavna, P.; Huang W. E.; Thornton, S. F.  
Bio-electrochemically enhanced remediation of the subsurface

# Proof-of-concept

- Enhanced groundwater bioremediation using MFCs
  - **Microbial community**
    - Naturally present in groundwater
    - 25% *Geobacter* sp.
  - **Carbon source**
    - Phenol, cresols, xylenols
  - **NO nutrient addition**



# Experimental set up

MFC	Circuit	Anode	Cathode
CC-MFC	closed	contaminated	pristine sterile
OC-MFC	open	contaminated	pristine sterile
S-MFC	closed	contaminated sterile	pristine sterile

## Measured parameters:

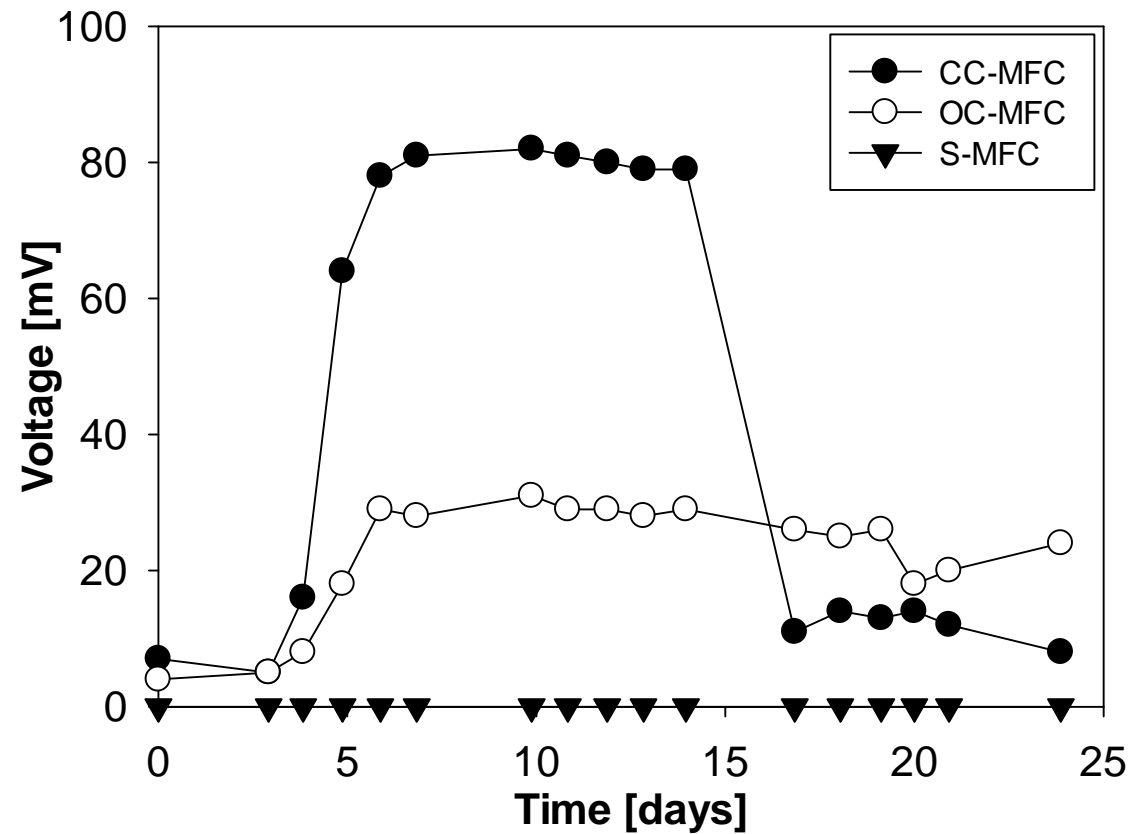
- Electricity production
  - Closed circuit voltage
  - Polarization and power curve
- Concentration of phenolic compounds



# Electricity production

Closed circuit voltage

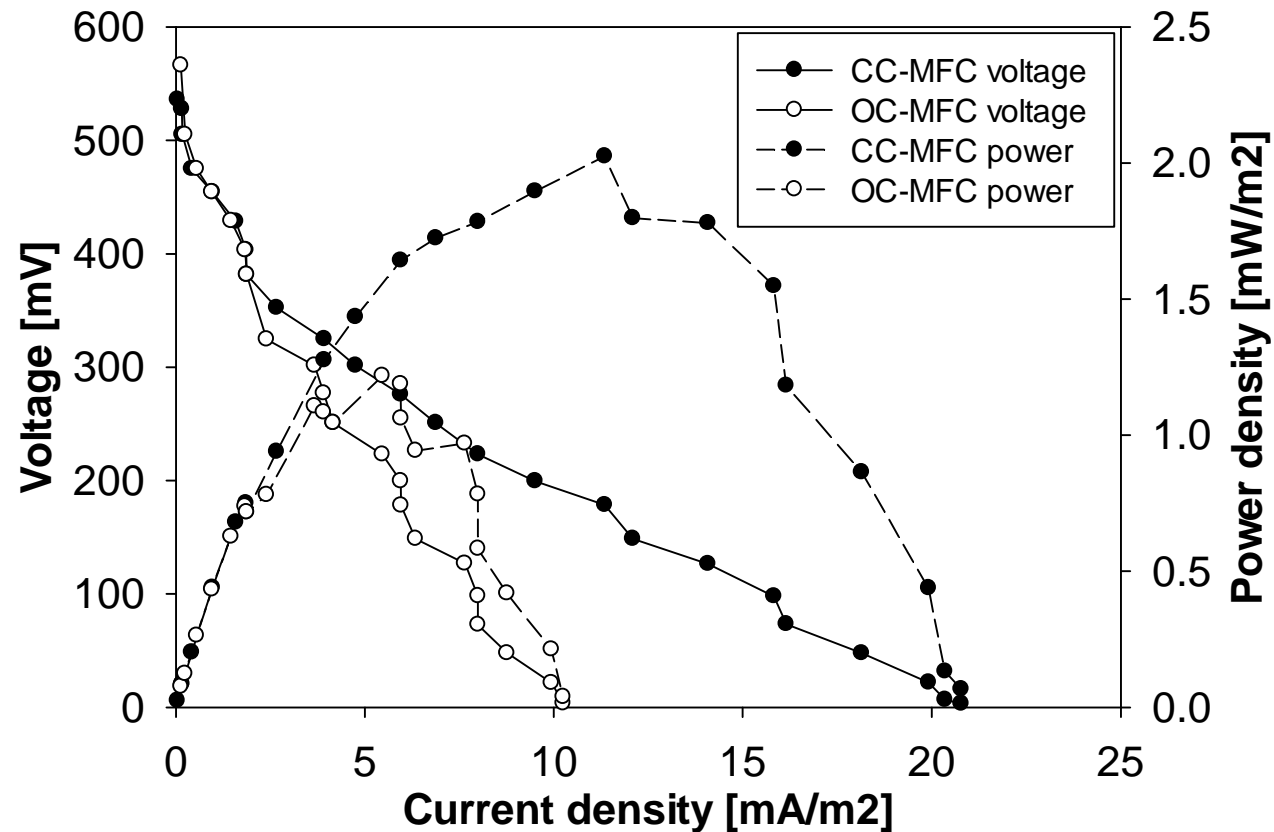
Polarization curve  
Power curve



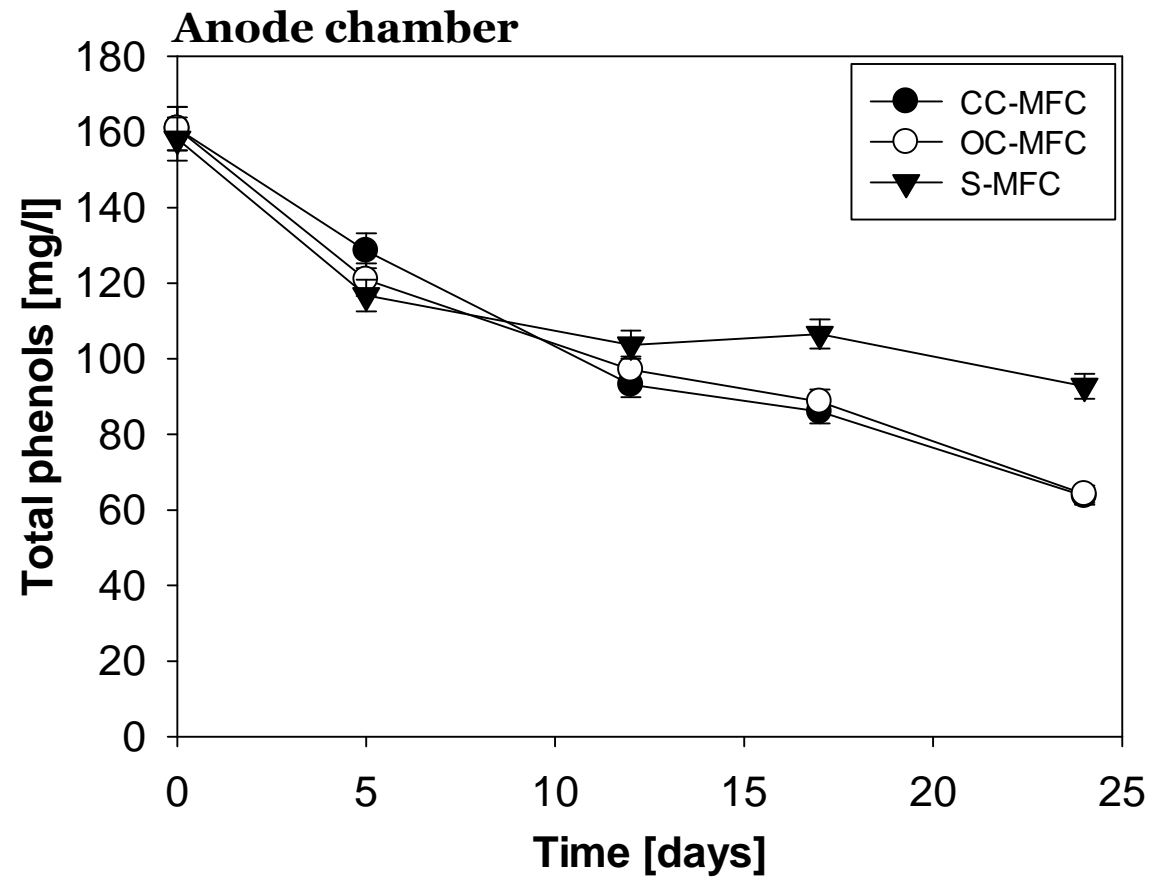
# Electricity production

Closed circuit voltage

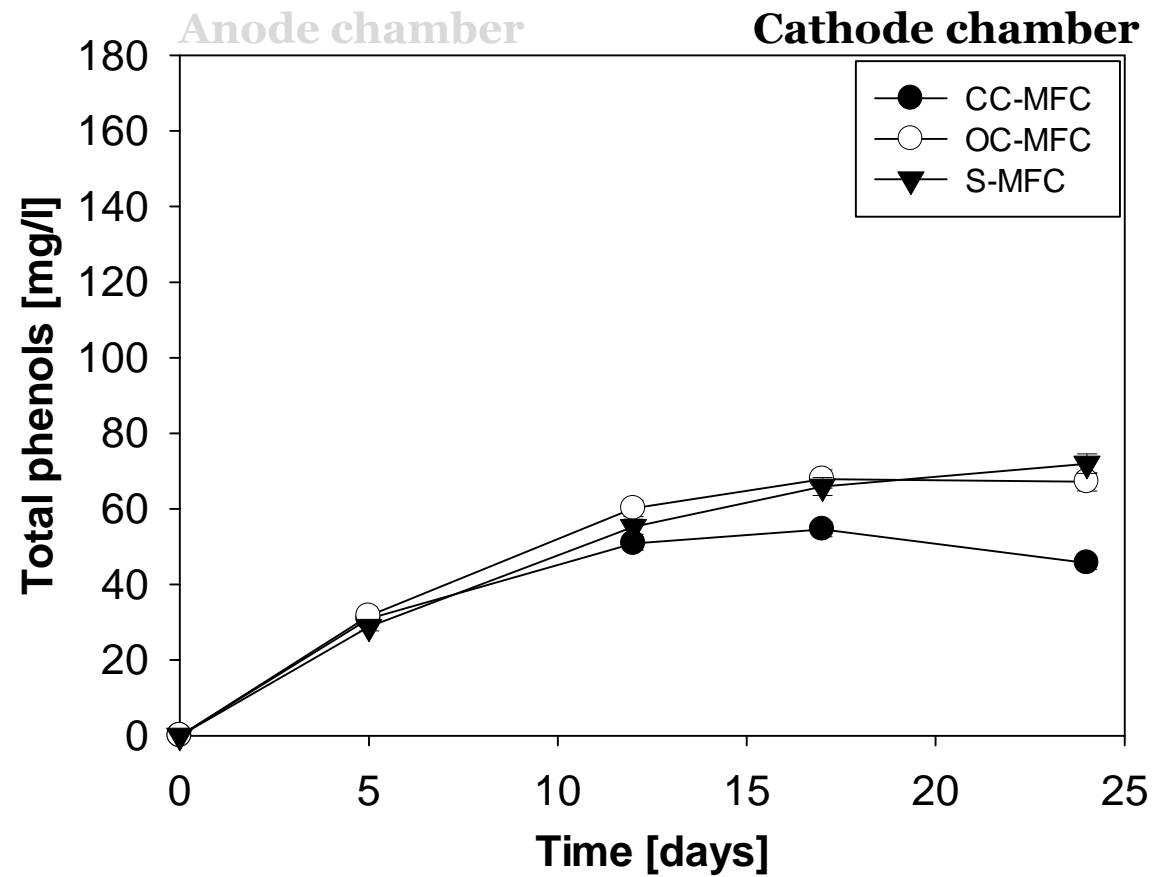
Polarization curve  
Power curve



# Degradation of phenolic compounds



# Degradation of phenolic compounds



# Conclusion

- Proof-of-concept
  - Power production production  $2.0 \text{ mW/m}^2$
  - Bioremediation enhanced by 17%

