

# EcoStick Introduction

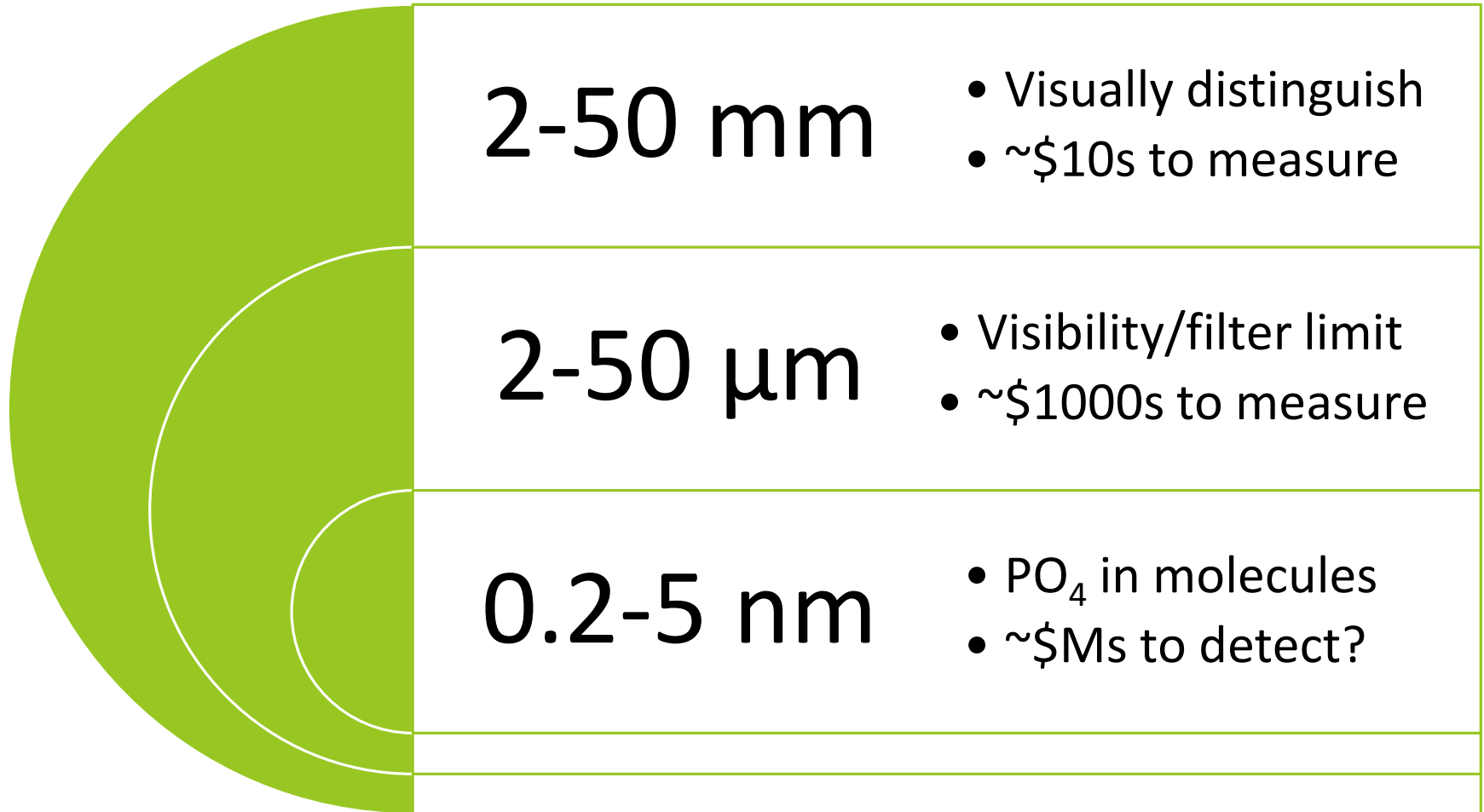
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Breakout Biofuels

Chatham, June 26, 2019

*"If you can't measure it, you can't improve it."*

# Scale and Context



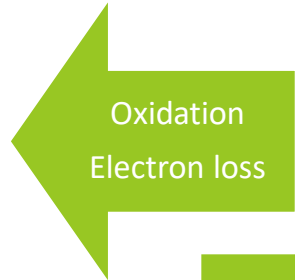
# Bloom-forming Cyanobacteria



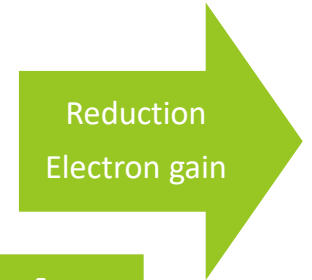
50  $\mu\text{m}$

Photo: John Wehr of Fordham University

*"What drives life is a little electric current, kept up by the sunshine".*



# Oxidation State



+5	+4	+3	0	-1	-3	-4
	CO <sub>2</sub>	HCOO <sup>-</sup>	C	HC=CH	-CH <sub>3</sub>	CH <sub>4</sub>
NO <sub>3</sub> <sup>-</sup>	NO <sub>2</sub>		N <sub>2</sub>	NH <sub>2</sub> OH	NH <sub>3</sub>	NH <sub>4</sub> <sup>+</sup>
PO <sub>4</sub>		HPO <sub>3</sub>	P <sub>4</sub>	H <sub>2</sub> PO <sub>2</sub>	PH <sub>3</sub>	

- “Particulate” P is in PO<sub>4</sub> form, possibly complexed with Fe or Ca; “dissolved reactive” P might have a different oxidation state
- Species and uptake dependent on T, light, oxygen, ORP, pH, turbidity
- Determination requires careful sampling, transfer to laboratory, filtration, oxidation, spectrophotometry

# EcoStick

- Inexpensive, tough, waterproof PCB construction
- Suitable for in-stream, in-pipe or in-field installation
- Battery-powered, low power draw for extended deployment
- Simple to use, no chemicals or consumables
- Wireless data transfer with backup data storage on SD card
- Monitor water level, temperature and complex electrical impedance with negligible impact on flow
- Simultaneous electrical capacitance and conductance
- Remote management
- 'Real-time', on-demand or user-adjustable scheduled data collection
- Adaptable for a variety of field-conditions and applications
- At Roesch farm, test whether a direct correlation can be made to total P load or to laboratory methods of measuring P

# EcoStick Applications

Track vertical movement of air, water, chemicals or microbes:

- Infiltration
- Compaction
- Surface run-off
- Soil horizons
- Nutrient retention or loss
- Water quality indication
- Event mass loadings
- Erosion