Nutrient ~~Removal~~ ~~with~~ Algae!! Recovery thru

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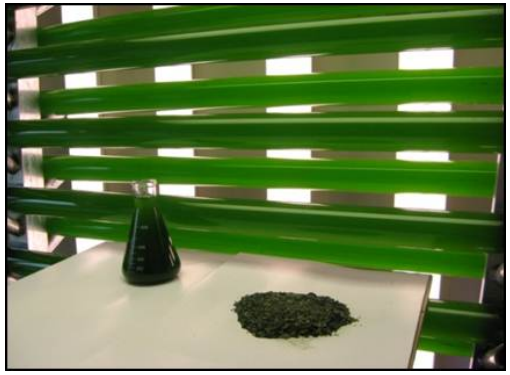
AlgEvolve

Company Brief



- **Founded 2007**
  - Bio-based technology to solve wastewater treatment challenges
- **Target Market**
  - Point source water dischargers (Municipal and Agro-Industrial)
- **Industry Challenges**
  - Lack of technology to meet low nutrient regulatory demands
  - Increasing cost / value of water
  - Demand for non-chemical based solutions
- **Patented Solution**
  - Renewable and sustainable approach to advanced, biological nutrient recovery
- **Project success in driving technology commercialization**
  - Municipal and Agro-Industrial (pulp & paper, anaerobic digestion, point-source agriculture, breweries, aquaculture, industrial commercial laundry)
- **Experienced and diverse management team**
  - Multi-sector expertise in commercializing technology in power generation, clean technology, information systems, financial services, supply chain management and semiconductor
- **Rebranding as CLEARAS Water Recovery to emphasize commitment to Water Recovery**

Growing Problem…

2009 EPA National Water Quality Inventory Report to Congress :

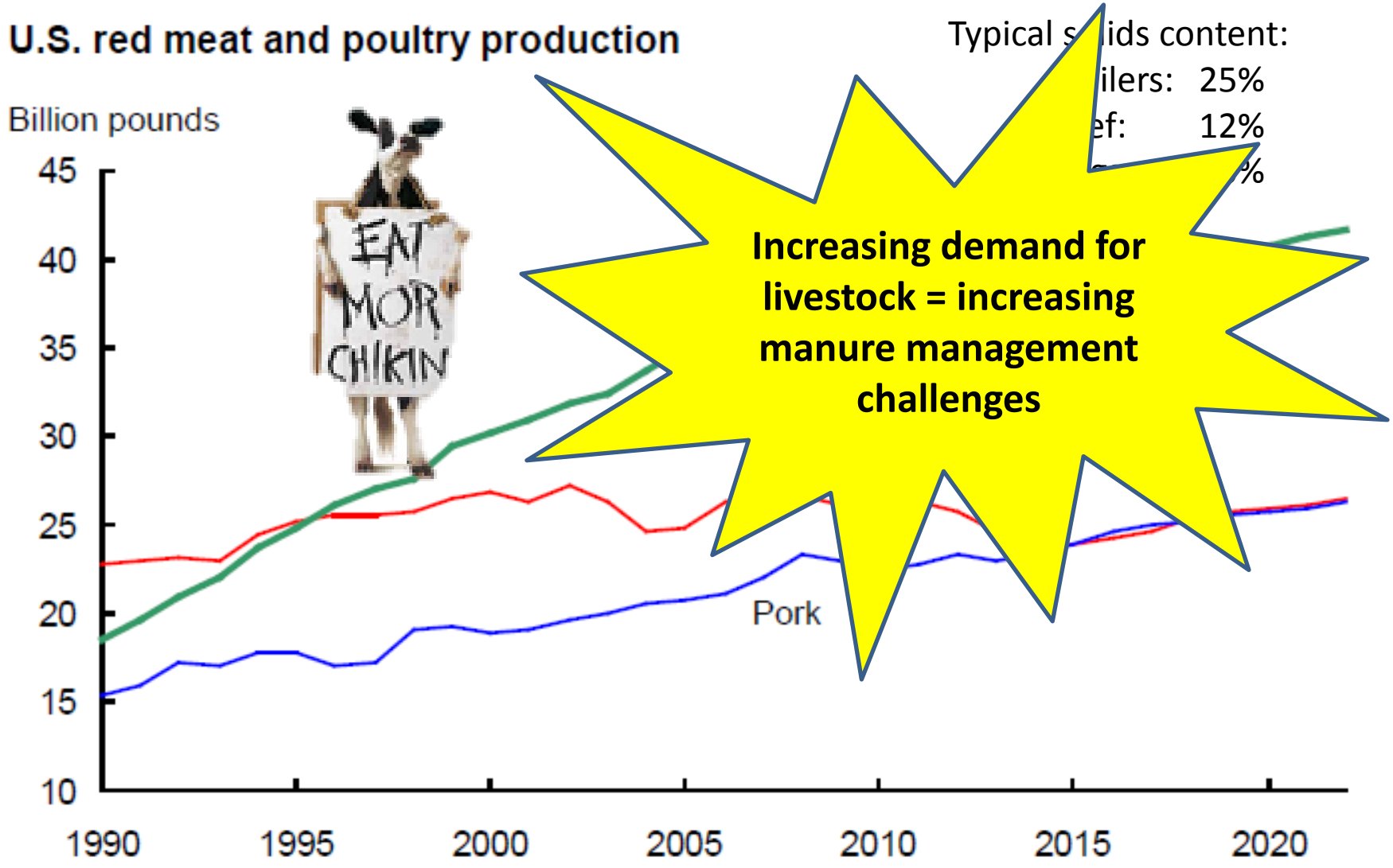
- **44%** of assessed river / stream miles impaired
  - Agriculture #1 source of impairment
- **64%** of assessed lakes, ponds and reservoirs impaired
  - Agriculture #3 source of impairment
- **30%** of assessed bays and estuaries impaired
  - Agriculture #9 source of impairment

"Projected increases in fertilizer use for food production and in wastewater effluents over the next three decades suggest there will be a 10-20 percent global increase in river nitrogen flows to coastal ecosystems."

Source: Global Environment Outlook: environment for development (GEO-4)

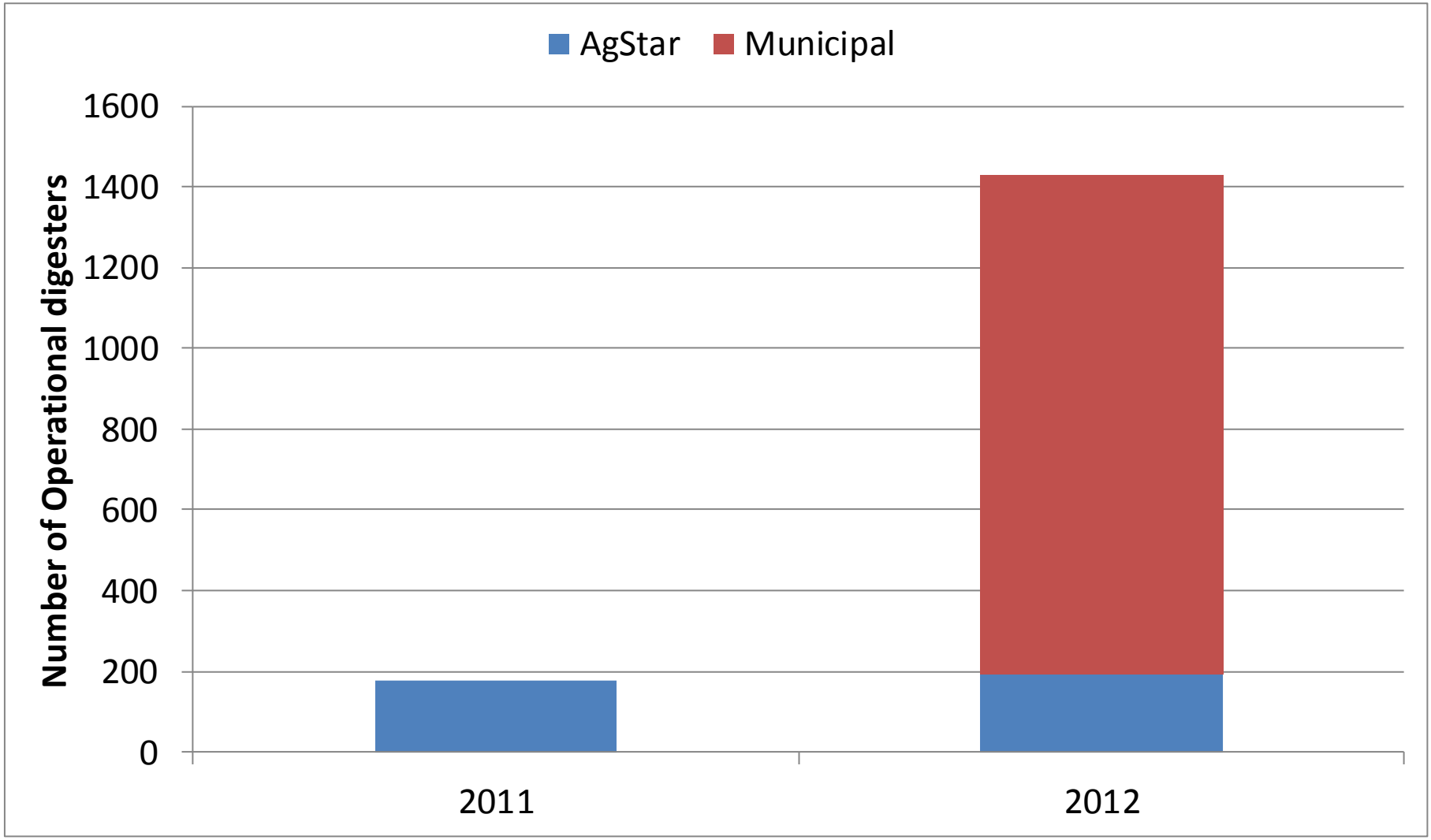
"When the well is dry, we learn the worth of water" – Ben Franklin

USDA Long-term projections



USDA Long-range forecast

Anaerobic Digester installations



Advanced Biological Nutrient Recovery™ (ABNR)

Algae as a process / service

- US Patent 8,101,080

Proven in multiple industry verticals

- Municipal Wastewater
- Agricultural
- Pulp & Paper
- Beverage
- Ethanol Production
- Anaerobic Digestion
- Industrial Laundry
- Fish Processing
- Aquaculture
- Chemical and Fertilizer

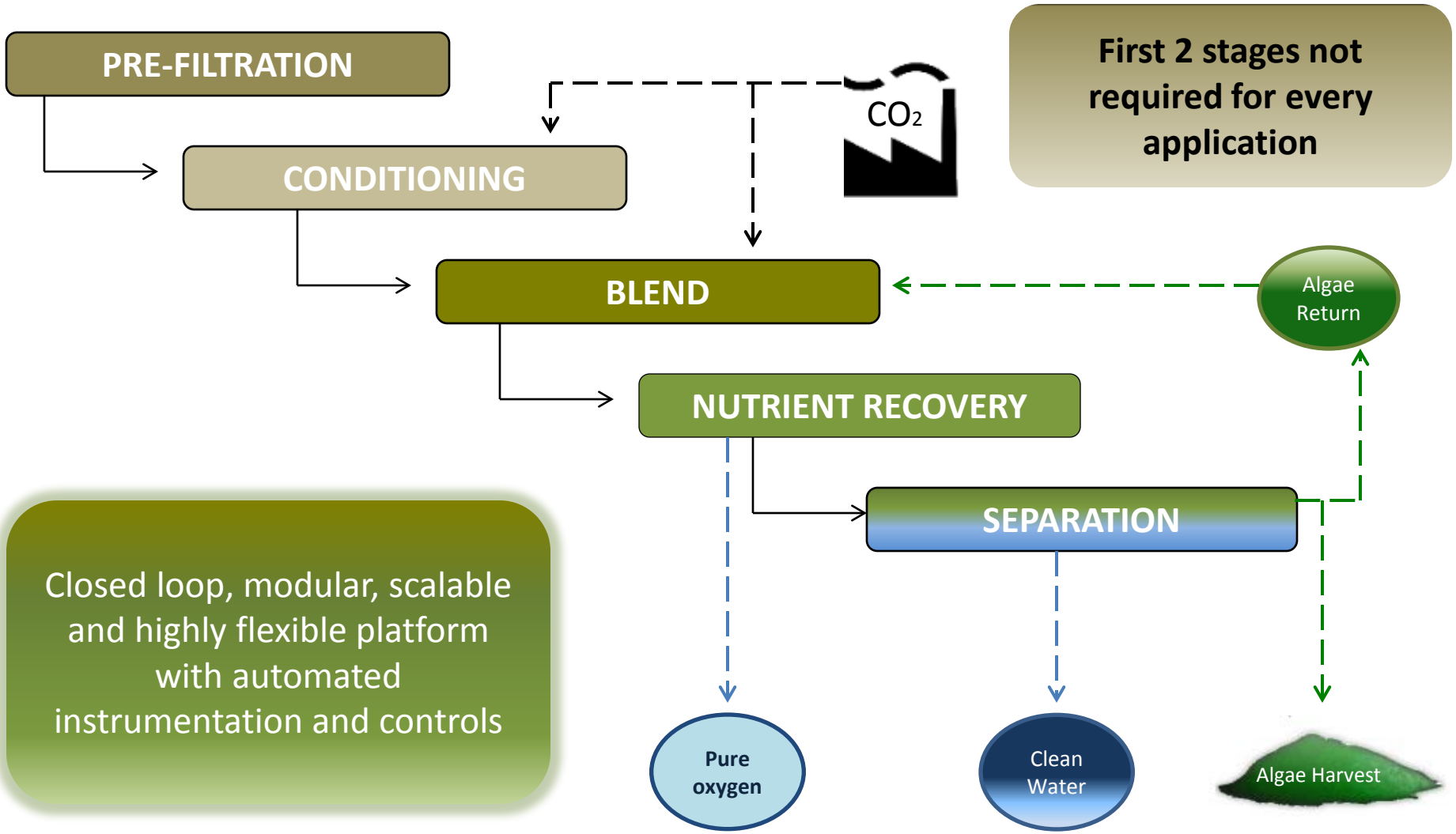
Algae biomass – a potentially valuable byproduct

CO_2 consumption – a potentially beneficial benefit

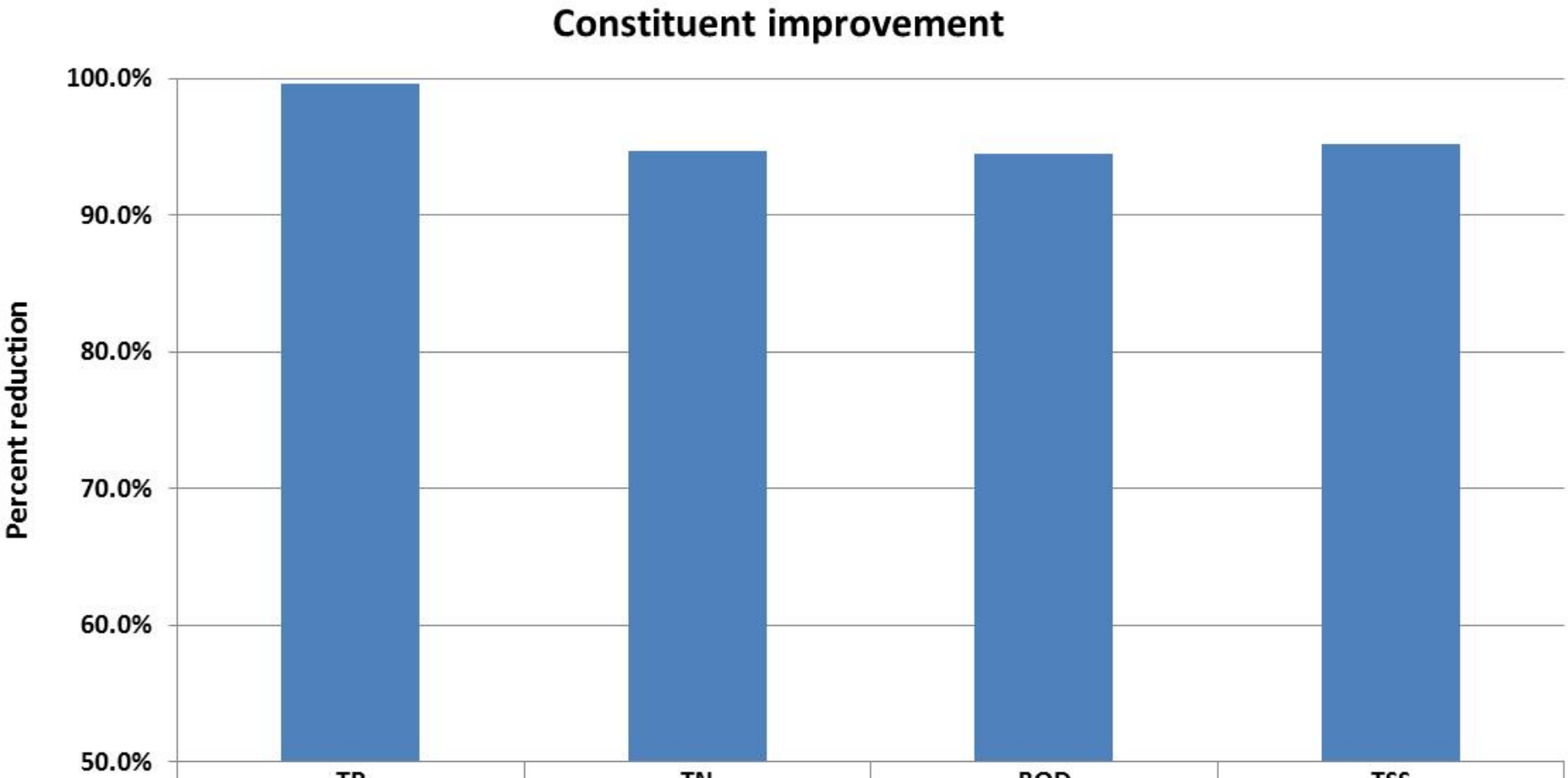
O_2 release – a valuable benefit

Reusable water – an even more valuable result

Technology Overview



Overall Technology Results



	TP	TN	BOD	TSS
Improvement	99.6%	94.7%	94.5%	95.1%

Algae Biomass

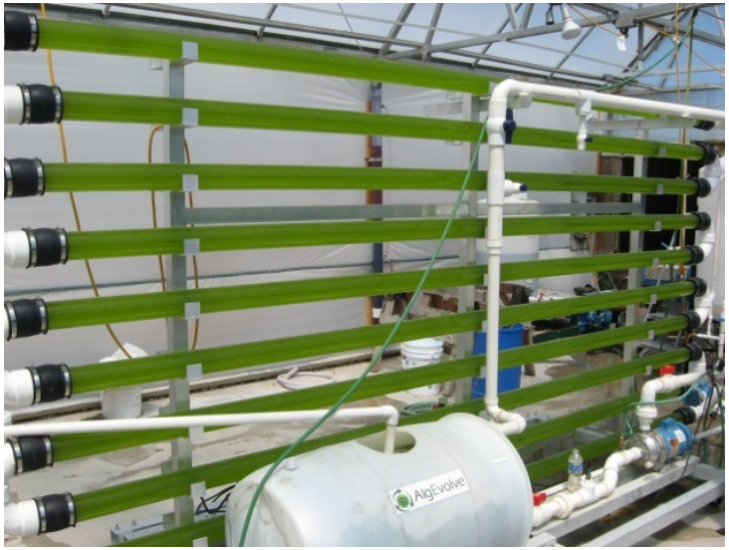
ALGAE BIOMASS FACTS

Crude protein: 39% - 50%
Crude fat: 1.61% – 7.75%
Ash: 8.57% – 15.71%
Carbohydrates: 28.1% – 31.26%

Select Amino Acid	Biomass, %	Typical nutritional requirement, %	
		Poultry	Swine
Methionine	0.82	0.50 – 0.62	
Lysine	2.48	0.97 – 1.36	0.57 – 0.79
Threonine	2.03	0.67 – 0.84	0.37 – 0.51
Isoleucine	1.78	0.70 – 0.91	0.41 – 0.56
Valine	2.60	0.82 – 1.03	0.41 – 0.56
Arginine	5.16	1.04 – 1.47	0.16 – 0.23
Histidine	0.67		0.15 – 0.20
Tryptophan	0.35		0.10 – 0.13
Leucine	3.40		0.48 – 0.68

Digester evaluations

Site	EPA Region	Type	Primary feedstock	Starting, mg/l				
				TP	TN	NH3	BOD	TSS
1	5	Centrate	Mixed	122	2910	2850	1270	668
2	5	Digestate	Mixed	2500	6880	3450	6720	59400
3	1	Digestate	Mixed	386	2430	1100	2400	30500
4	1	Digestate	Mixed	2180	7100	4070	18700	72600
5	5	Digestate	Agriculture	12.4	146	106	850	251
6	8	Centrate	Municipal	178	320	229	3000	2600
7	8	Centrate	Municipal	Pending				
8	4	Centrate	Municipal	In process				



Nutrient Recovery Test

- Used to define mass balance for maximum uptake
- Provides initial Process definition
- Approx 80 gallon capacity
- 50 gallons of effluent for test

Results – Site 1

Visual Results

Sample	Constituent, mg/l				
	TP	TN	NH3	BOD	TSS
Raw	122	2910	2850	1270	668
Treated	0.12	142	135	13	1

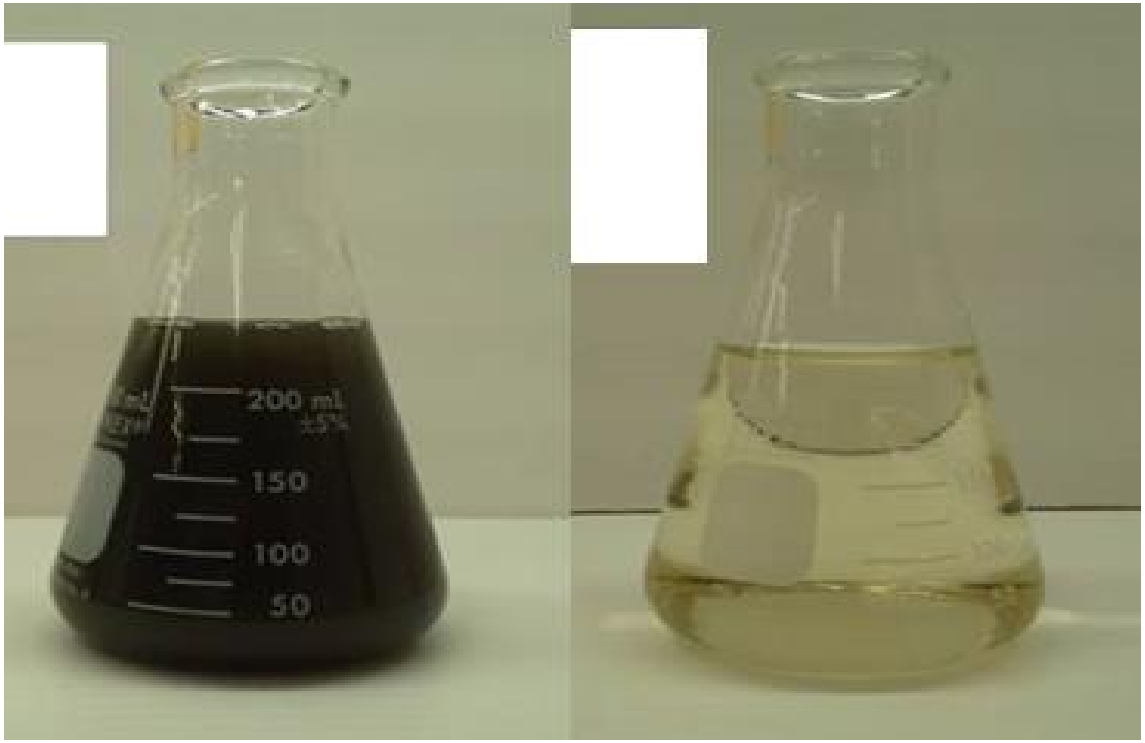
Results – Site 2

Visual Results

Sample	Constituent, mg/l				
	TP	TN	NH3	BOD	TSS
Raw	2500	6880	3450	6720	59400
Treated	0.24	82.4	71.3	25	ND

Results – Site 3

Visual Results



Sample	Constituent, mg/l				
	TP	TN	NH3	BOD	TSS
Raw	386	2430	1100	2140	30500
Treated	0.13	42.6	37.2	23	ND

Results – Site 4

Visual Results

Sample	Constituent, mg/l				
	TP	TN	NH3	BOD	TSS
Raw	122	2910	2850	1270	668
Treated	0.12	142	135	13	1

Results – Site 5

Visual Results

Sample	Constituent, mg/l				
	TP	TN	NH3	BOD	TSS
Raw	12.4	146	106	850	251
Treated	0.034	27.9	19.8	2	2

Results – Site 6

Visual Results

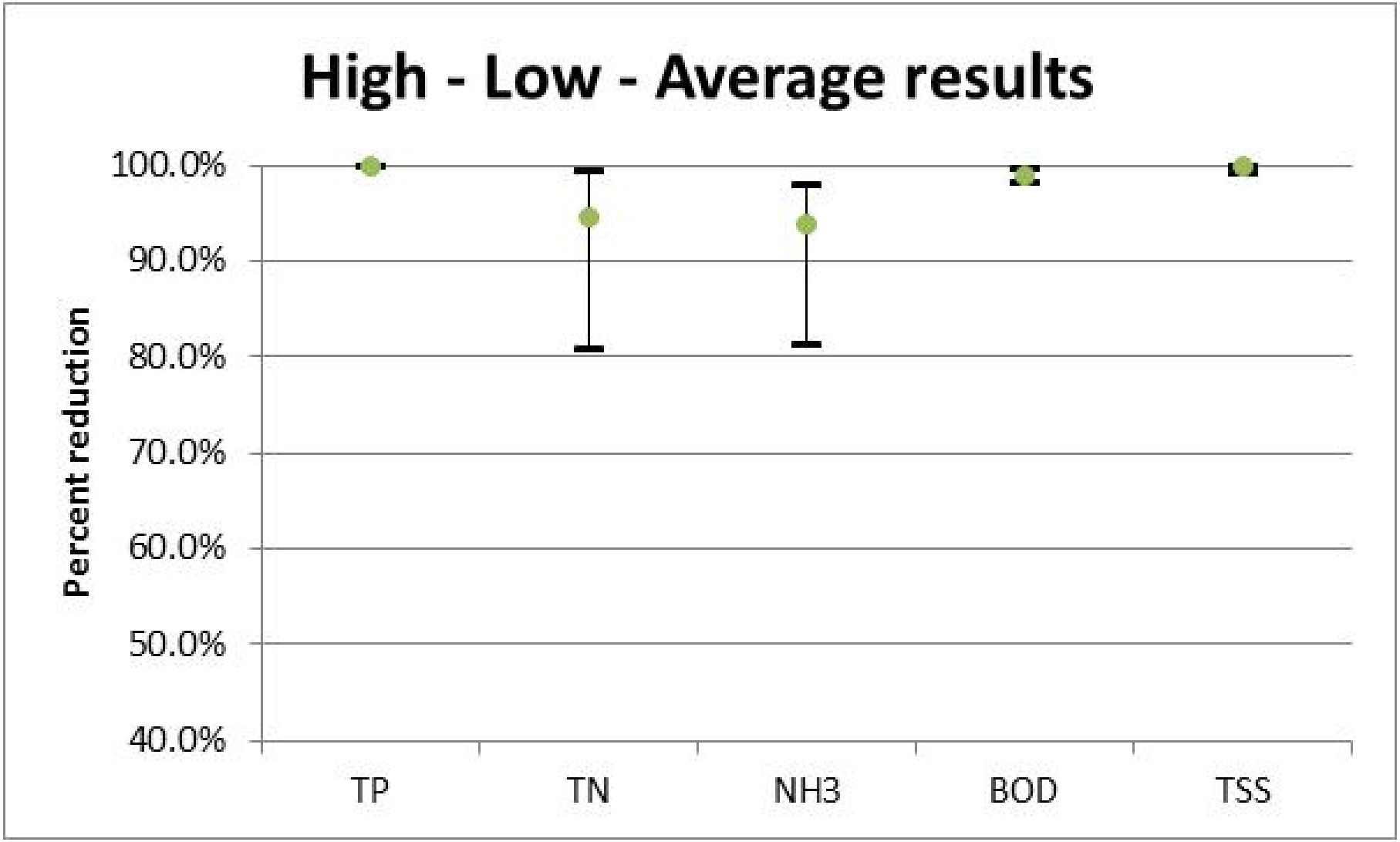
Sample	Constituent, mg/l				
	TP	TN	NH3	BOD	TSS
Raw	178	320	229	3000	2600
Treated	0.02	4.93	3.62	4	ND

Results – Site 7

Visual Results

Sample	Constituent, mg/l				
	TP	TN	NH3	BOD	TSS
Raw	Pending	Pending	Pending	Pending	Pending
Treated	Pending	Pending	Pending	Pending	Pending

Digester results



Next Steps

- **Complete centrate evaluations**
- **Complete 2-phase Pilot evaluations for Site 4**
- **Complete investigation into next generation process**
  - Improved economics
  - Improved efficacy

CLEARAS
WATER RECOVERY

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