Giving Wastewater a Boost with Breakthroughs in Secondary Treatment

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Research Director

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Contents

- Problems with existing wastewater treatment
- A picture of the "average" activated sludge plant
- Six innovative technologies go head to head

Stickney Water Reclamation Plant, Chicago

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Wastewater treatment gobbles energy and produces large volumes of sludge

- The dominant process for treating the world's wastewater, activated sludge, faces three major issues:

High energy consumption

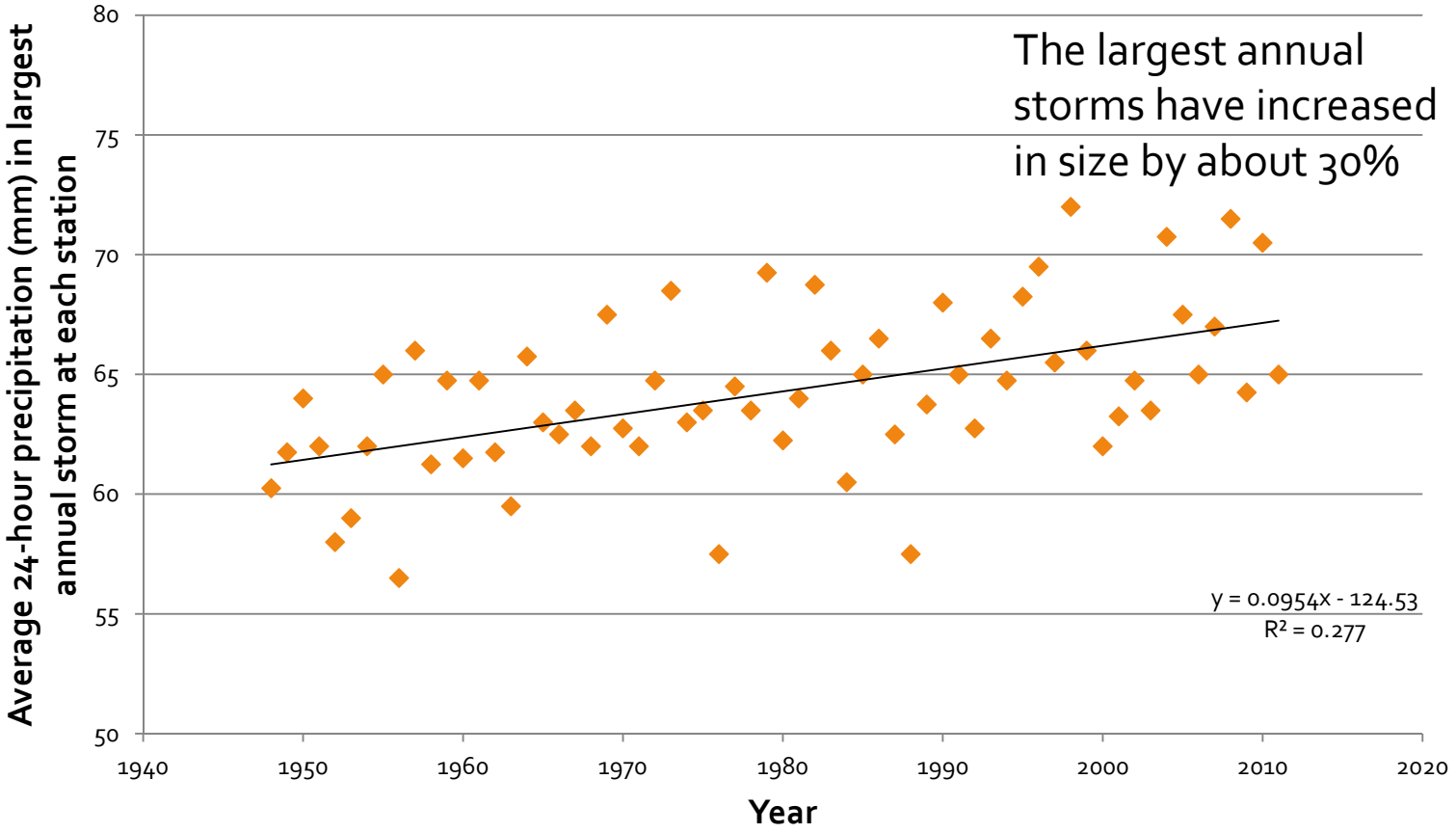
Mountains of waste sludge

The squeeze for space

Anaerobic digestion reduces, but doesn't eliminate waste sludge

- Does not scale down well
- Many facilities need to combine sludge with other waste streams
- Reduces sludge volume by about 40%, but you still have to do something with the remaining stabilized biosolids

Many U.S. wastewater plants will look to expand capacity due to population and climate pressures



Source: Environment America Research & Policy Center (2012).

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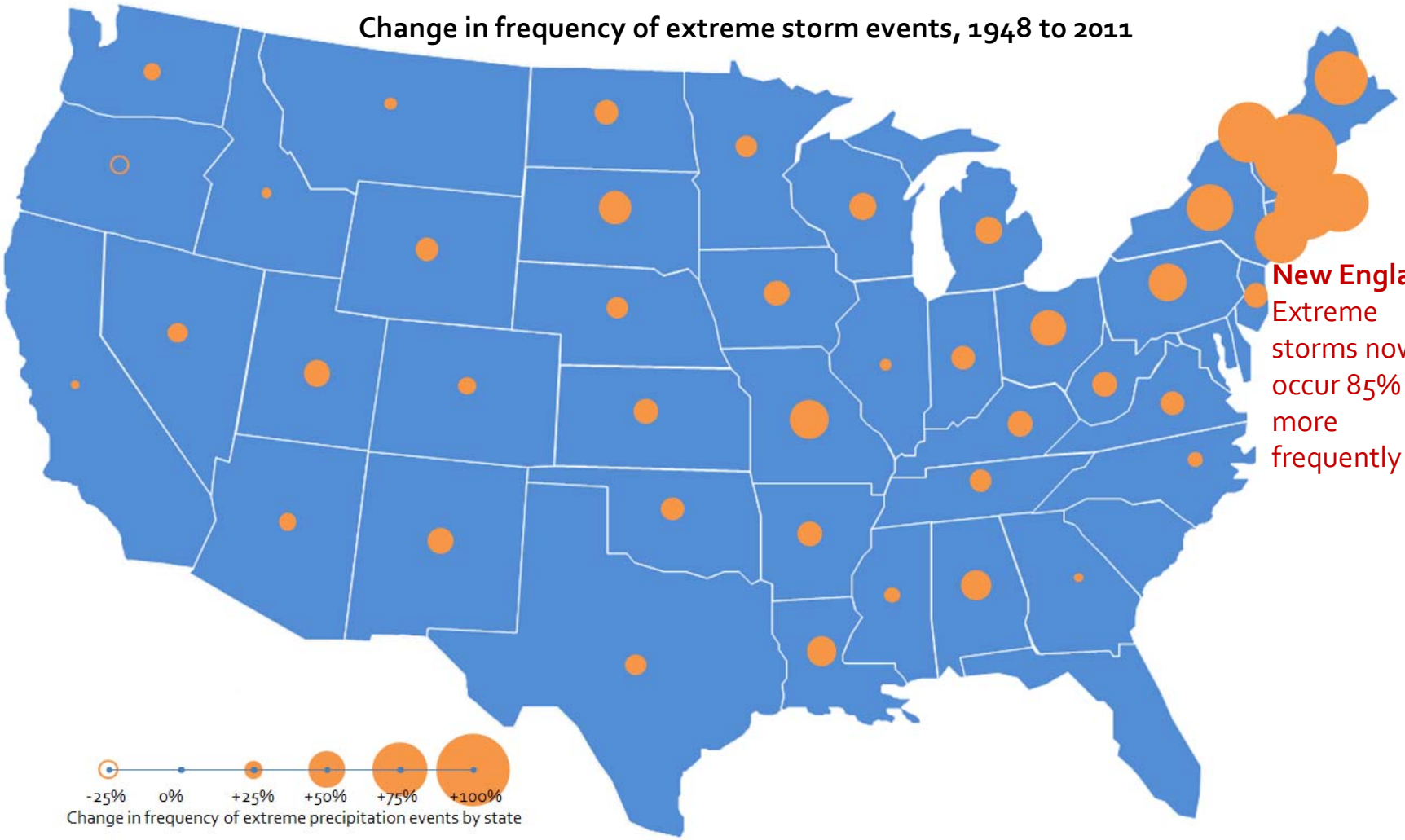

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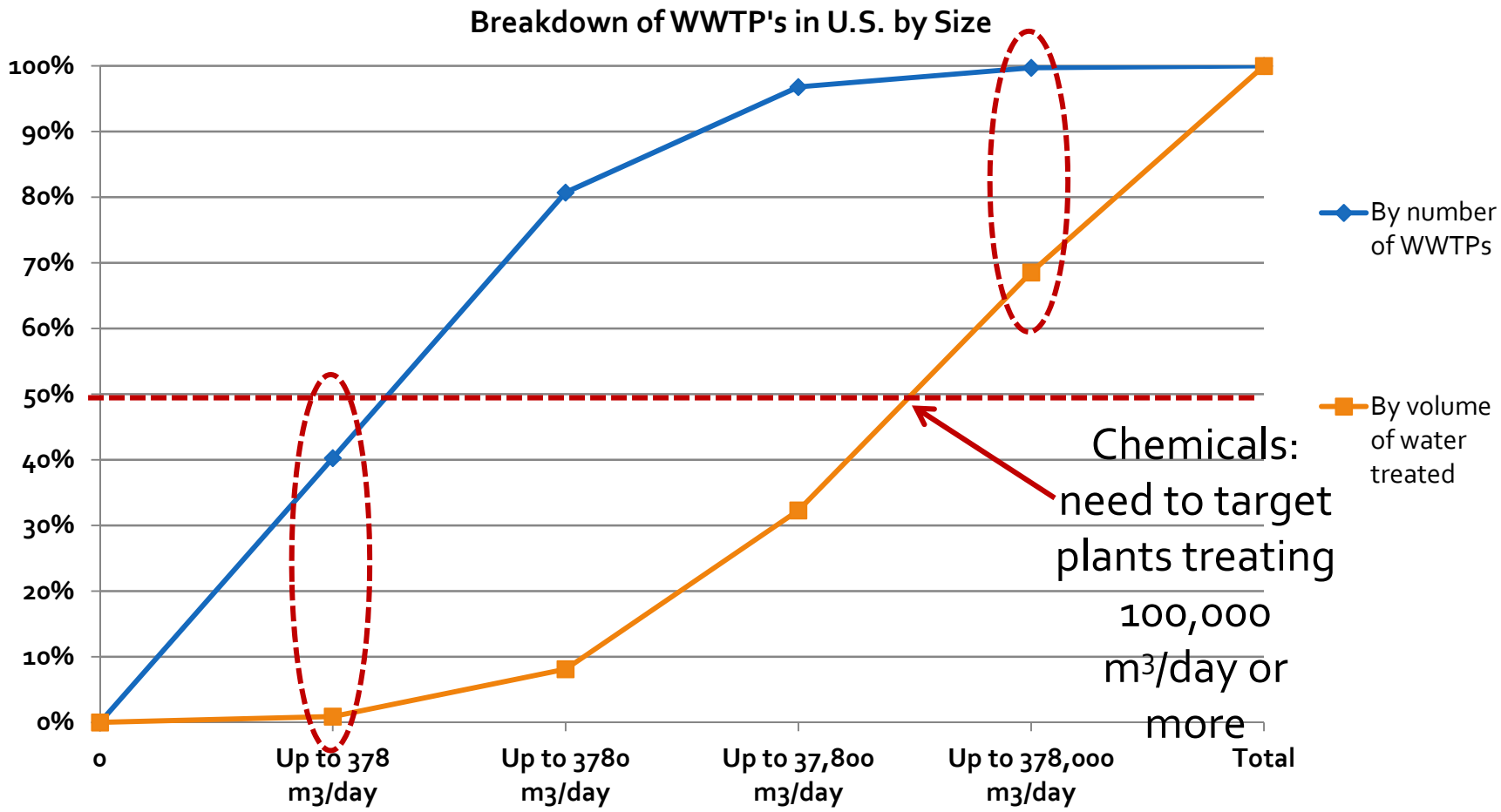
In the United States, a few mega-systems treat a large portion of the water



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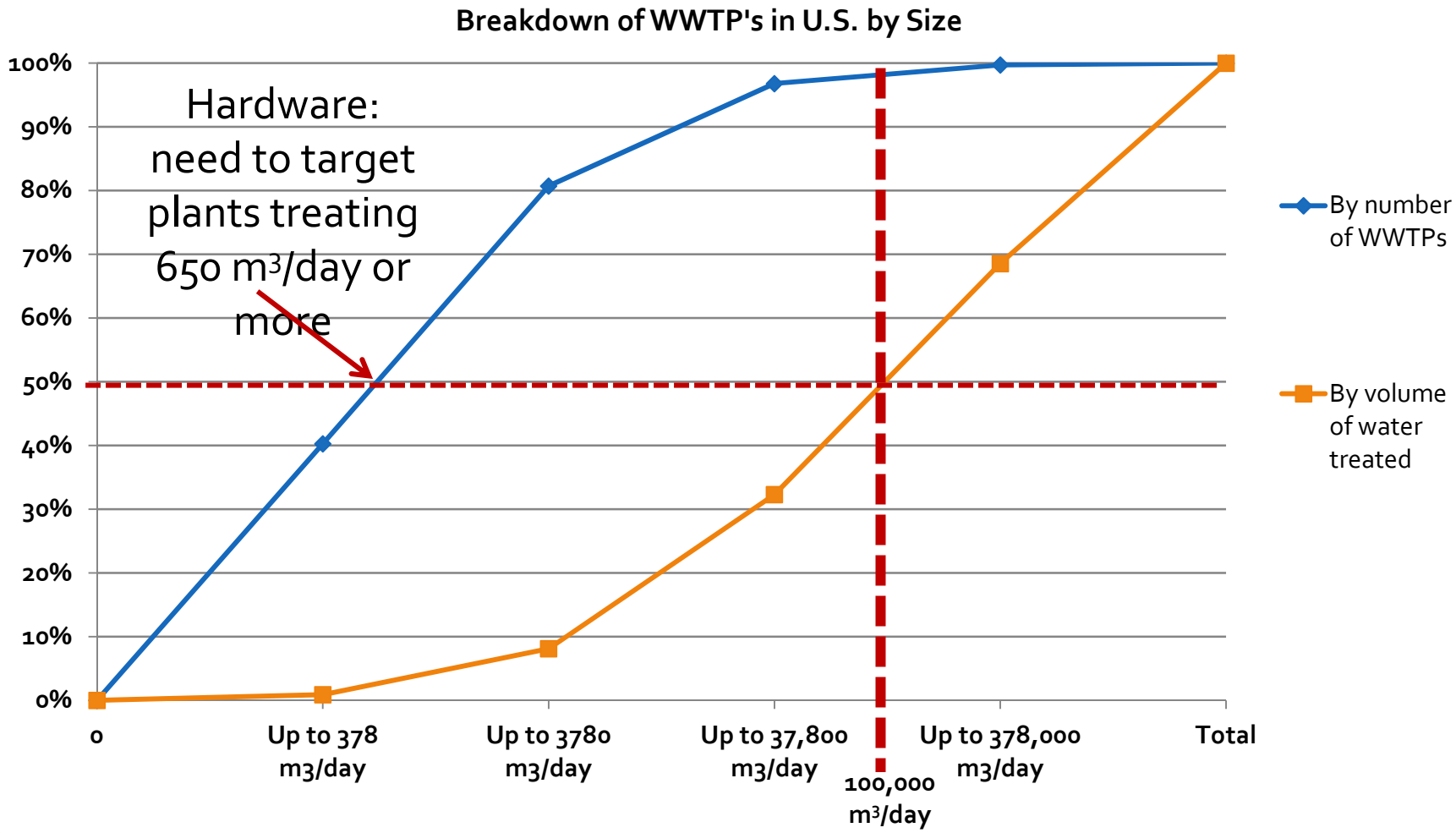

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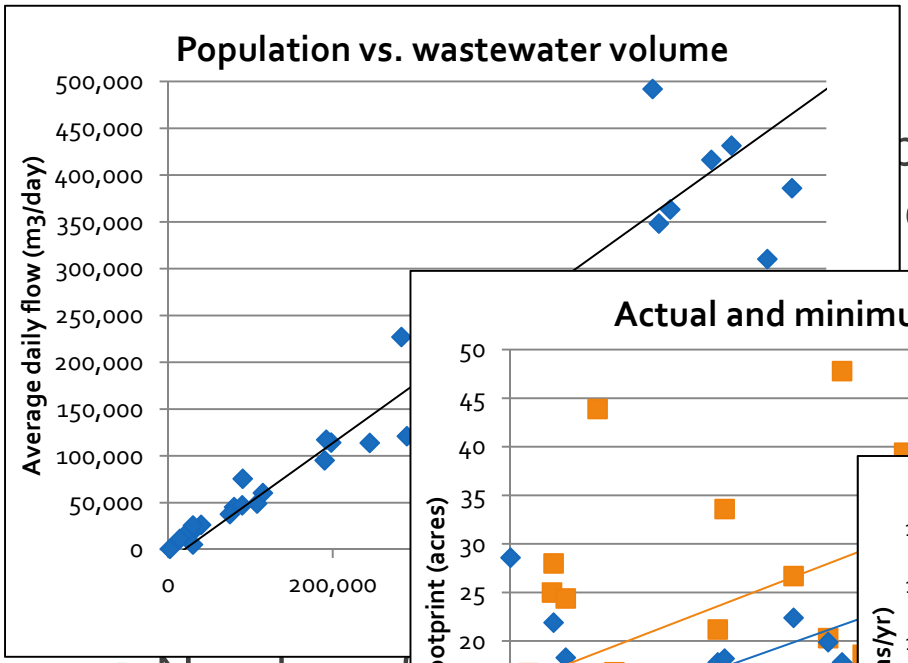
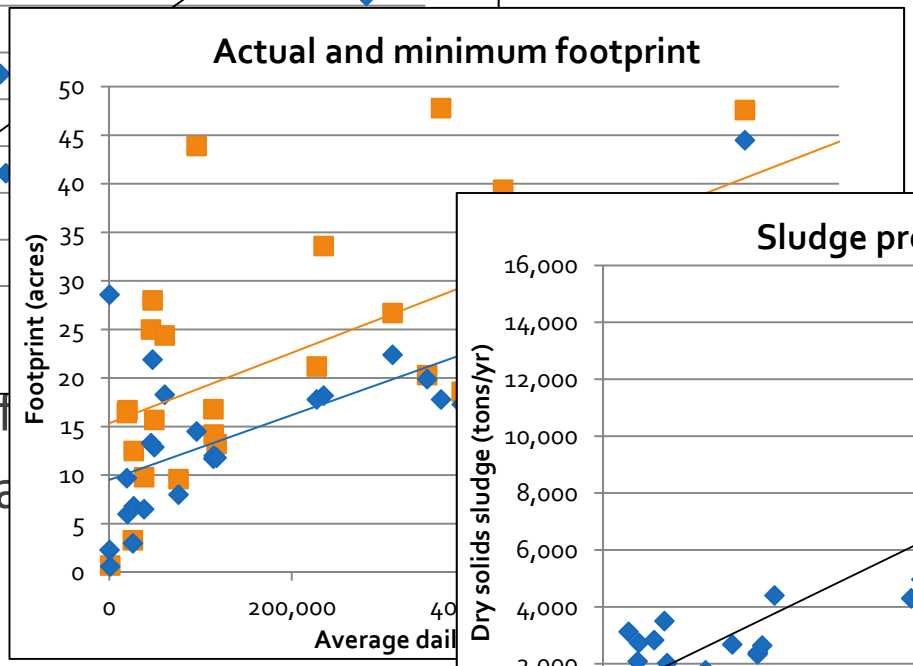
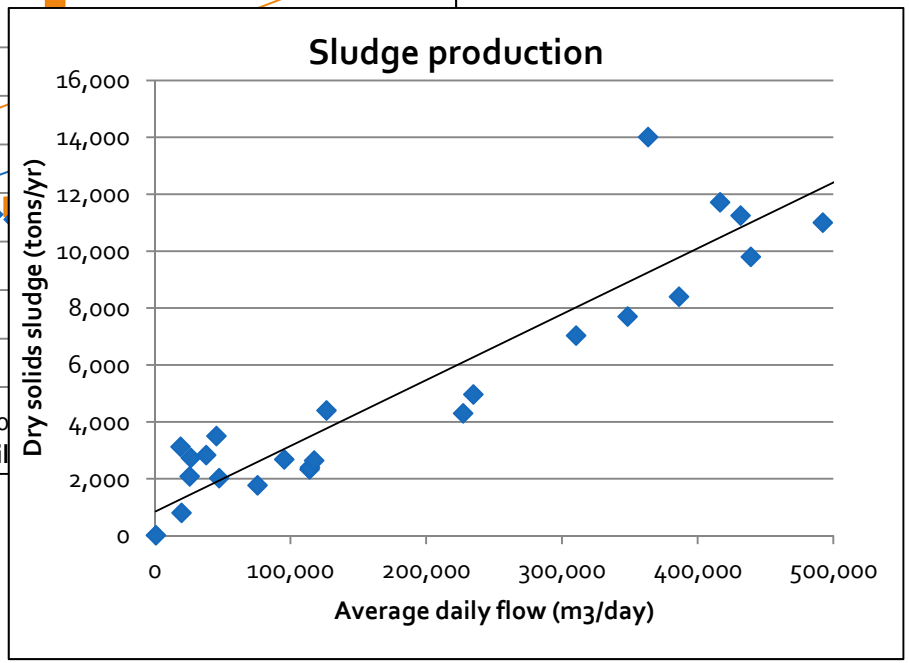
The "average" wastewater treatment plant







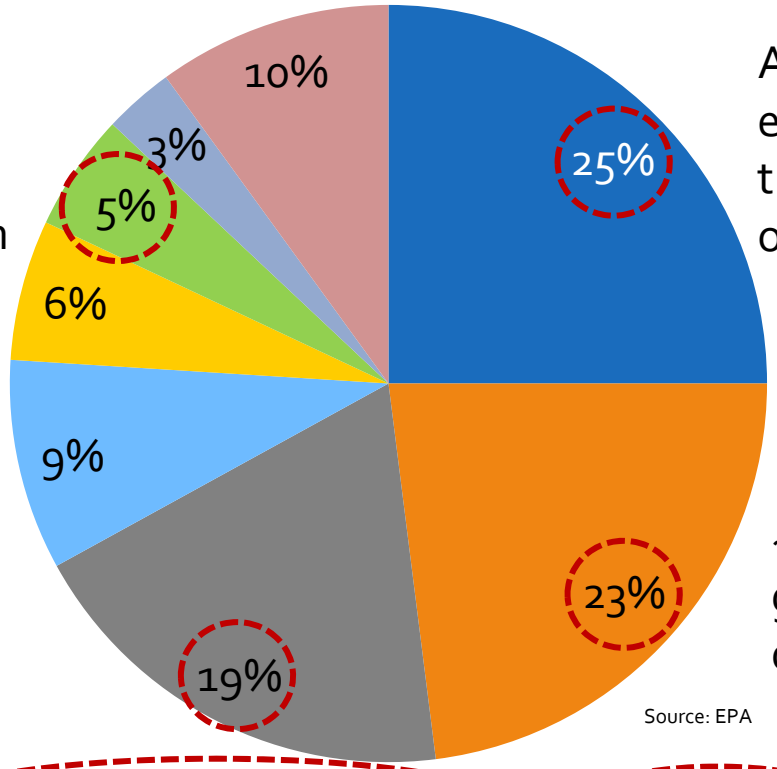
ble of activated sludge
ghout the U.S.

- Number of
- Footprint a

The "typical" U.S. 100,000 m³/day plant

- Wastewater volume: **100,000 m³/day**
- Population: **180,000 people**
- Energy consumption: **0.4 kWh/m³**
- Staff: **46**
- Sludge production: **3150 tons/year** dry, or **12,600 tons/year** at 25% solids
- Minimum footprint: **12.5 acres**
- Annual operating cost: **$4 million/year**

Operating cost breakdown for wastewater treatment



About 60% of sludge ends up in landfills, with tipping fees on the order of $35/ton

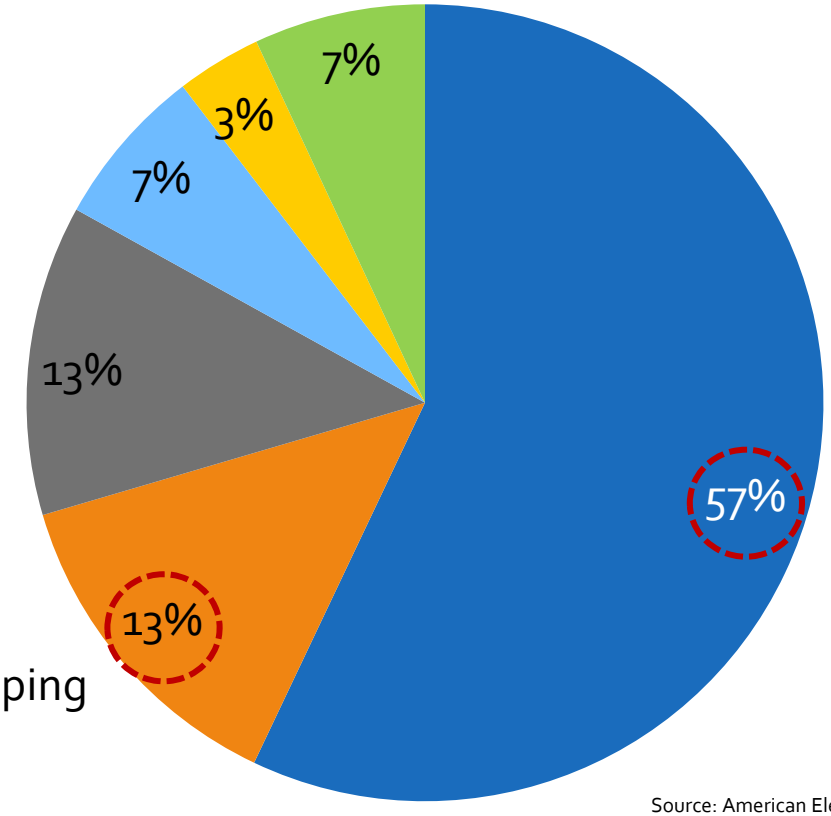
Plants often need supervision around the clock

~2% of all electricity generated in developed countries

Source: EPA

- Sludge transport/disposal
- Staff
- Chemicals
- Maintenance
- Electricity
- Discharge fees
- Administration
- Other

Energy breakdown for wastewater treatment



Includes all water and sludge pumping

Aeration efficiency is limited by the need to pressurize air in order to pump it into several meters of water

Source: American Electric Power, Hazen & Sawyer

- Aeration
- Anaerobic digestion
- Belt press
- Pumping
- Lighting/building maintenance
- Other

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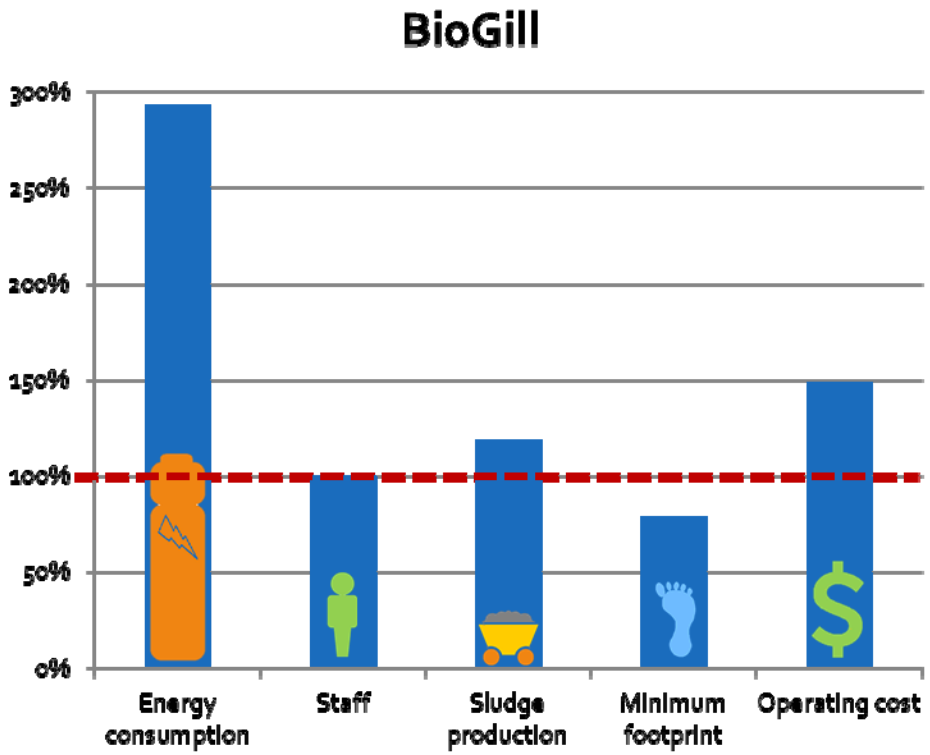
How we compared these technologies

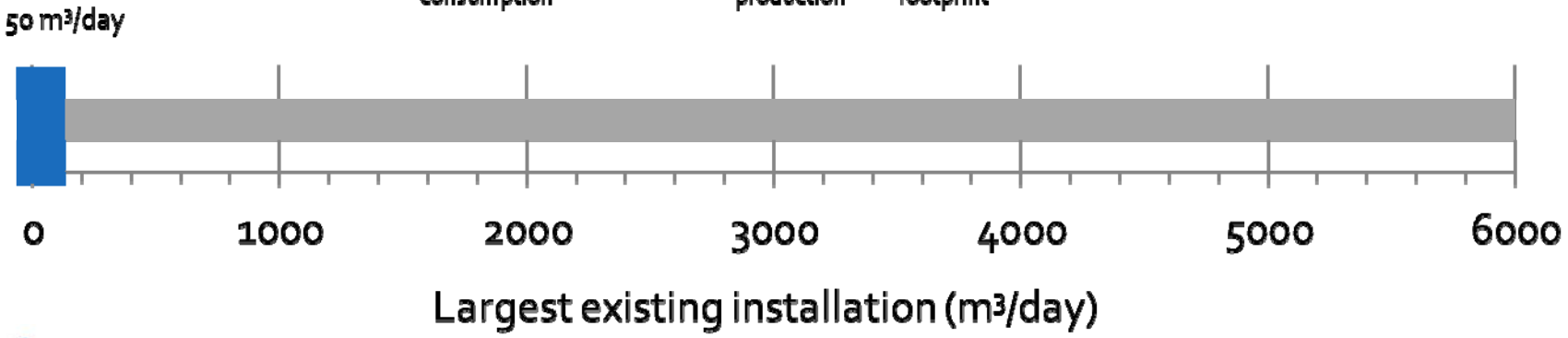
	Based in	Founded	Revenue	Employ-ees				
BIOGILL	Australia	2009	$2 million	12				
aquacell water recycling solutions	Australia	1996	$4 million	12				
Baswood	U.S.	2004	$7 million	20				
Emefcy Bio-Energy Systems	Israel	2007	Pre-revenue	25				
aquarius TECHNOLOGIES INC	U.S.	2006	$10 million	12				
OXYMEM	Ireland	2013	$500,000	27				

1 BioGill

- Ceramic "gill" material supports biofilm
- Gills create passive aeration and allow biofilm to slough off due to gravity

1 BioGill





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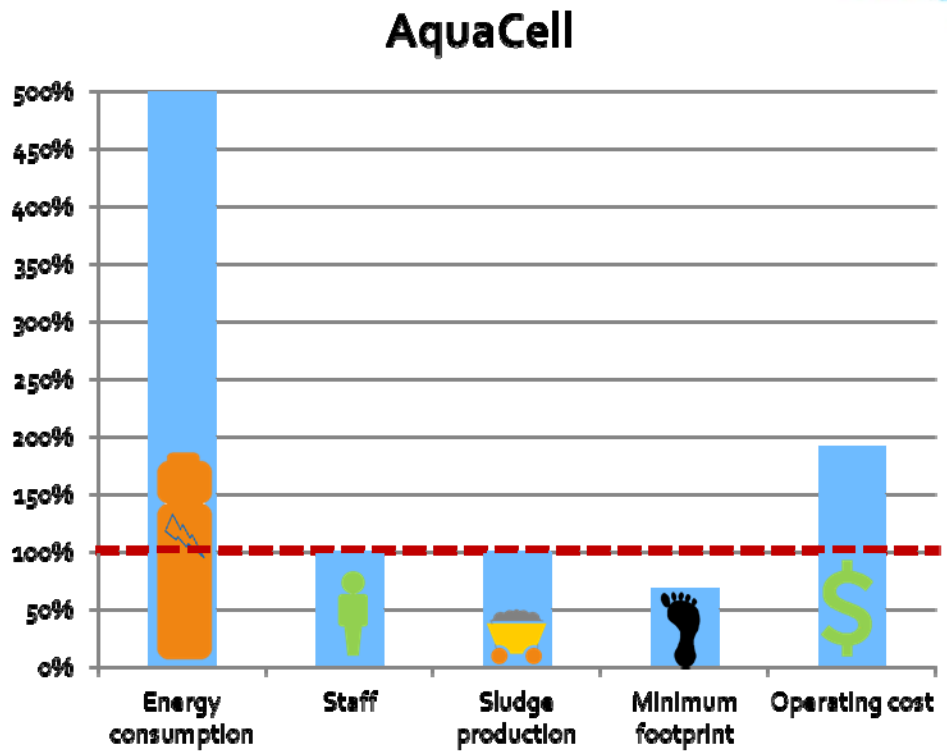
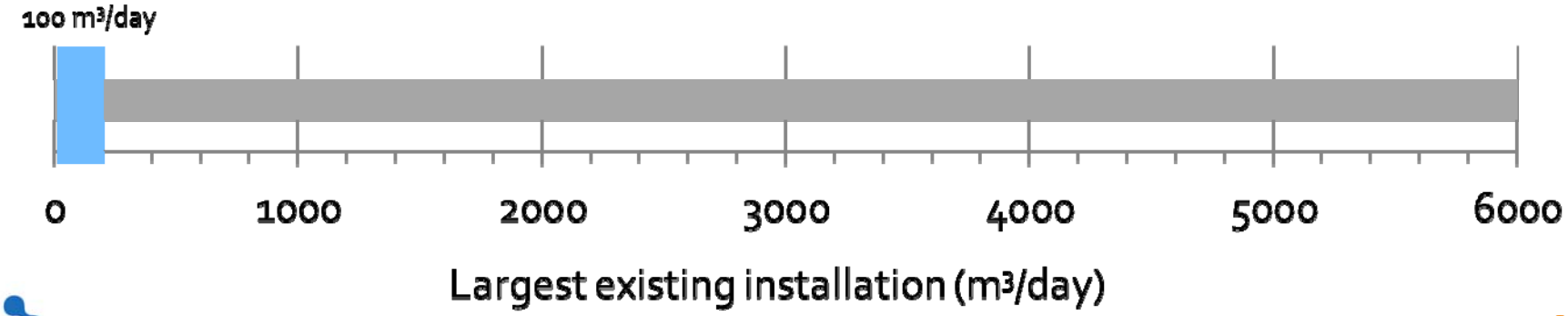
2 AquaCell

- Membrane bioreactors provide high-quality effluent
- Focus on graywater and blackwater recycling systems within a building or campus

2 AquaCell





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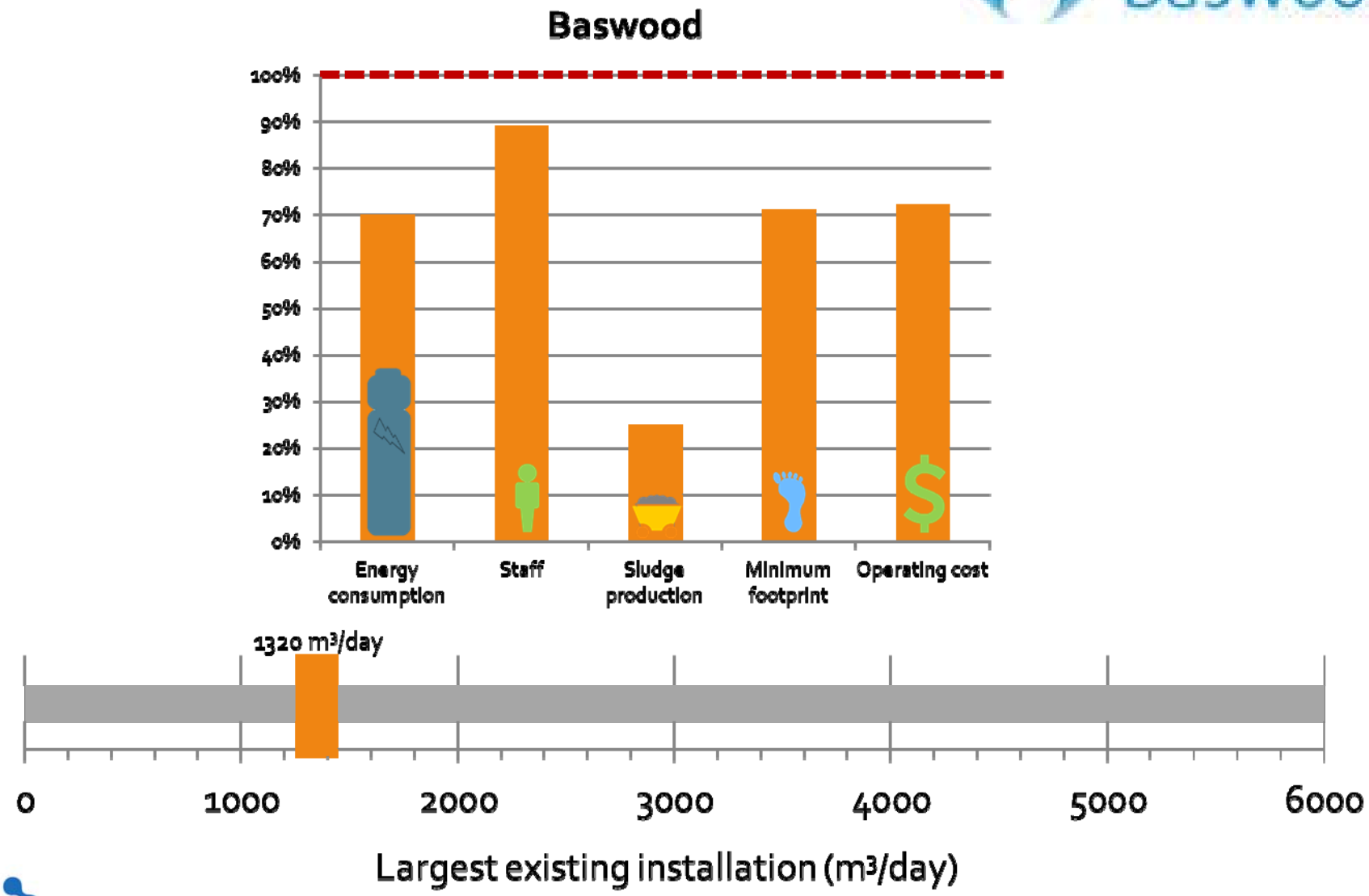
3 Baswood

- Separates secondary treatment into three reactors
- "Dry cycle" reduces sludge volume and removes old biomass

3 Baswood



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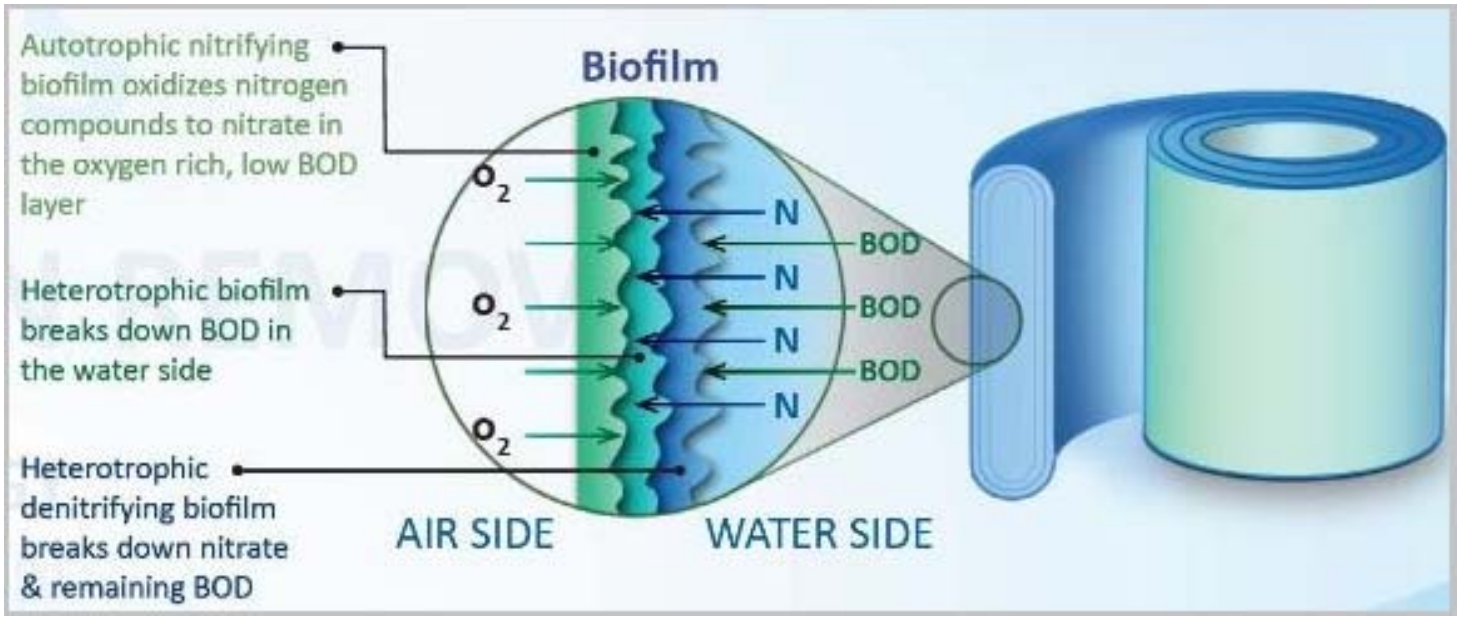
4 Emefcy Sabre (Spiral Aerobic Biofilm Reactor)

- Another take on passive aeration
- Spiral shape with biofilm on inside
- Incorporates a backwash cycle



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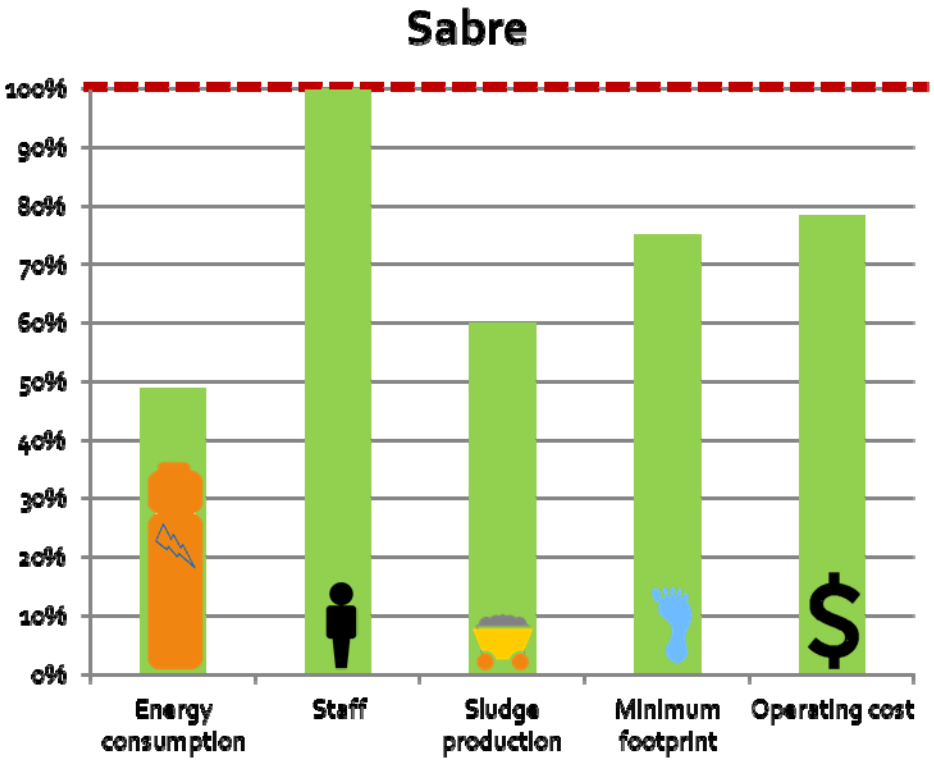

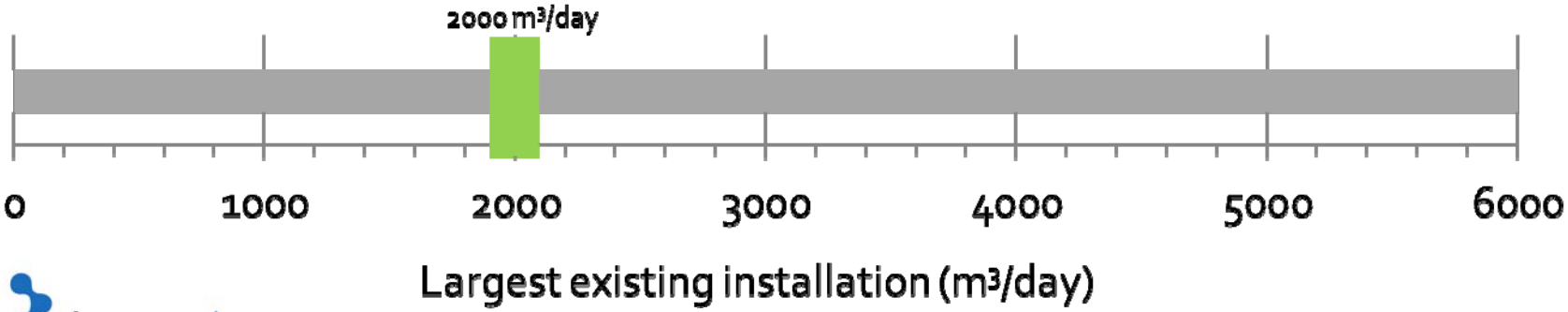

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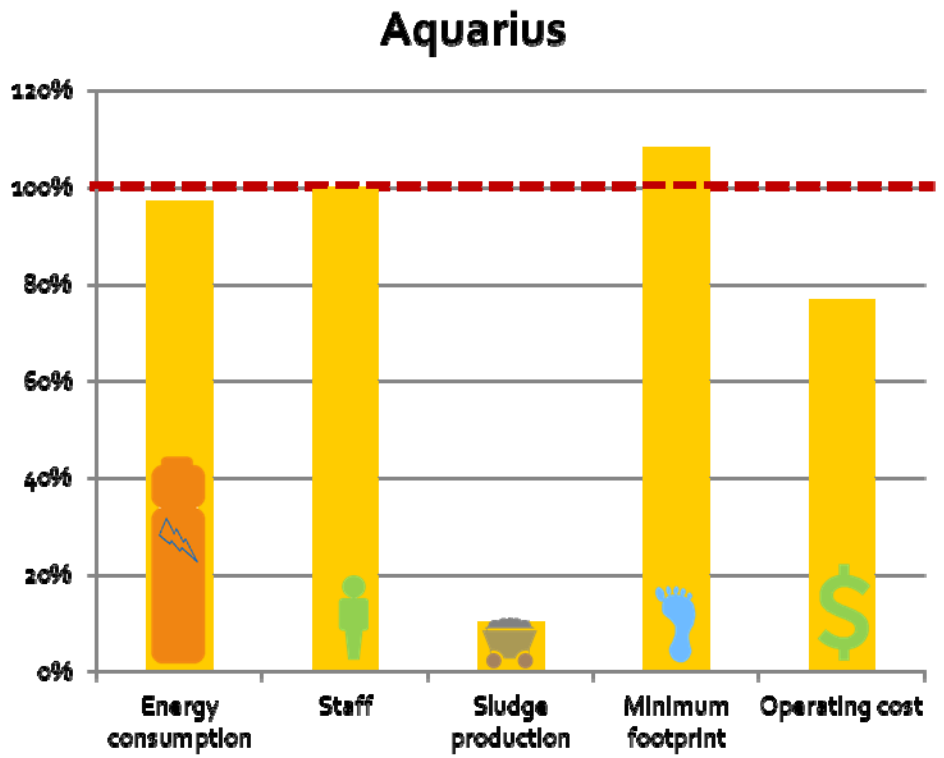
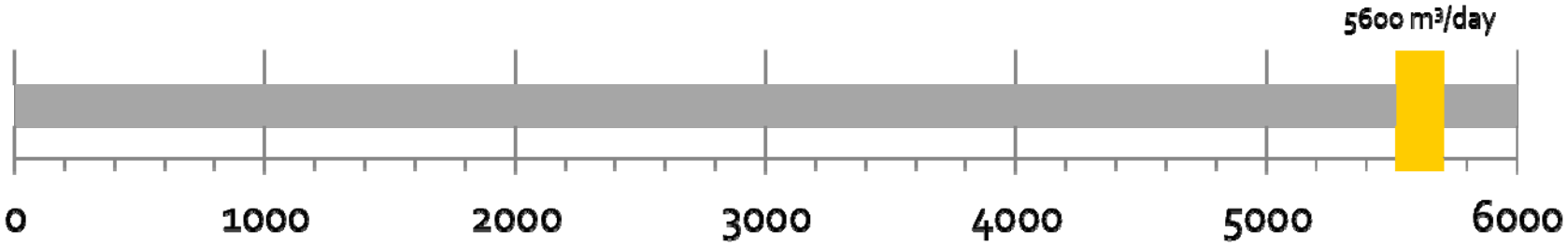
5 Aquarius Technologies

- Incorporates many different zones with slightly different conditions
- 18 to 24 hours of aeration

5 Aquarius Technologies





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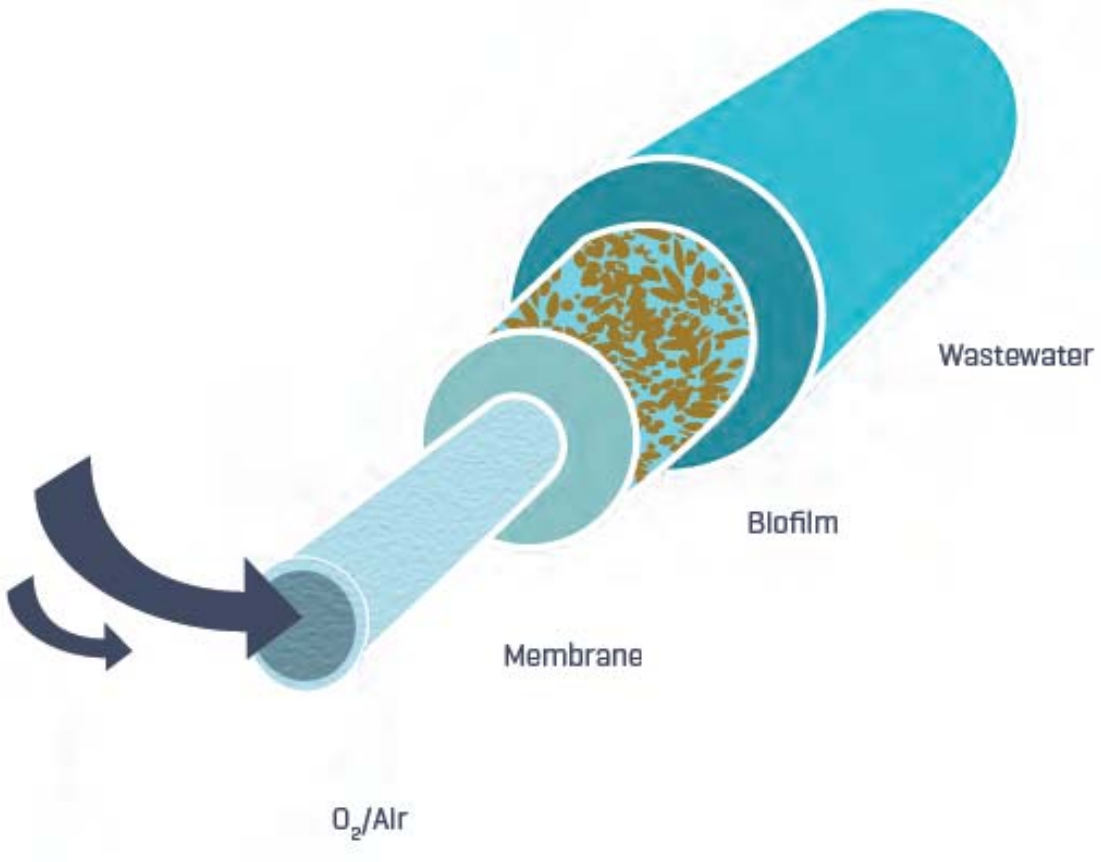
6 OxyMem

OXYMEM
SMART AERATION



- Membrane Aerated Biofilm Reactor (MABR) provides air through the inside of hollow fiber membrane
- Monitors biofilm growth by nitrogen production
- Developing easy-retrofit solution

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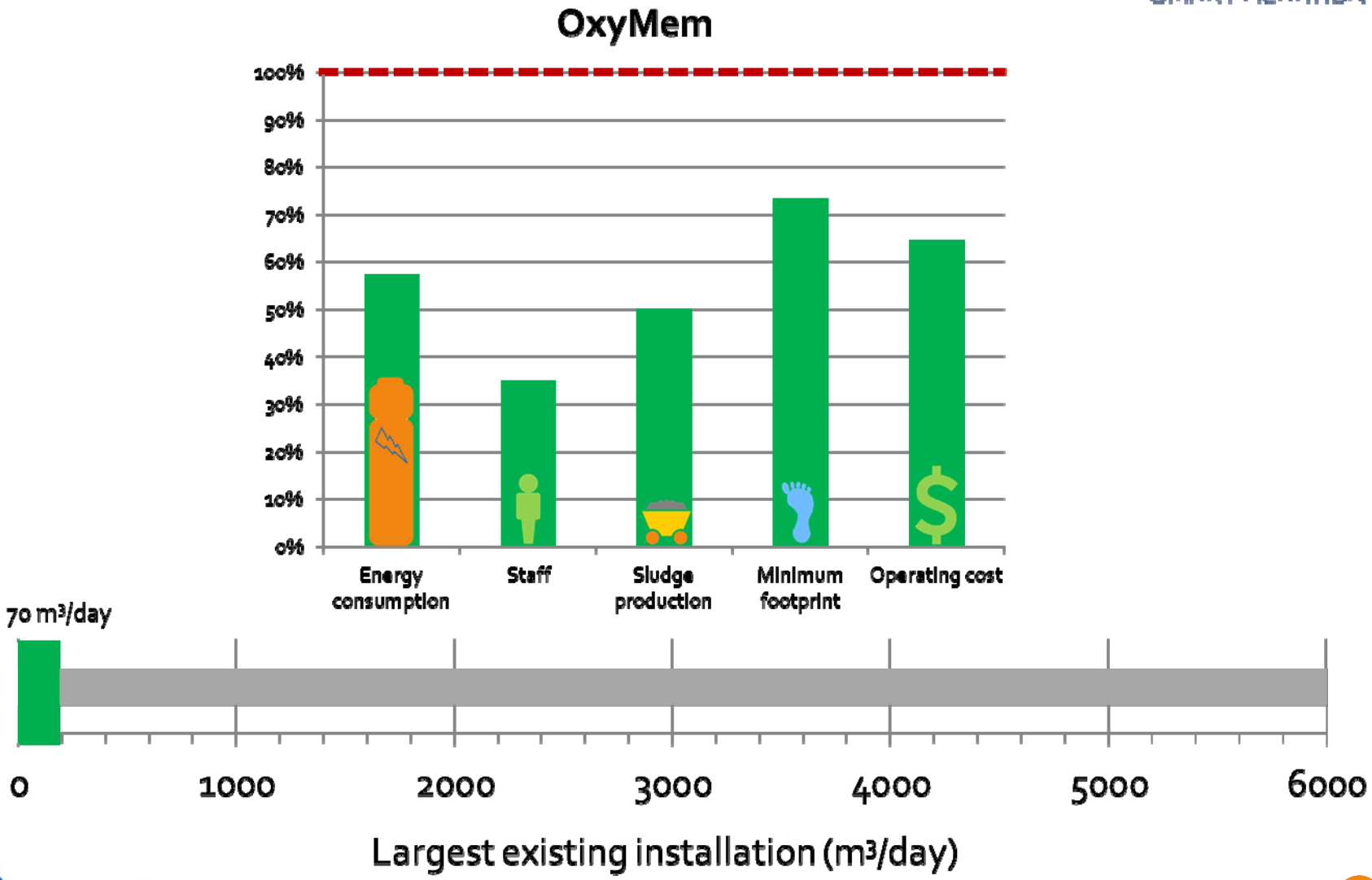
SMART AERATION



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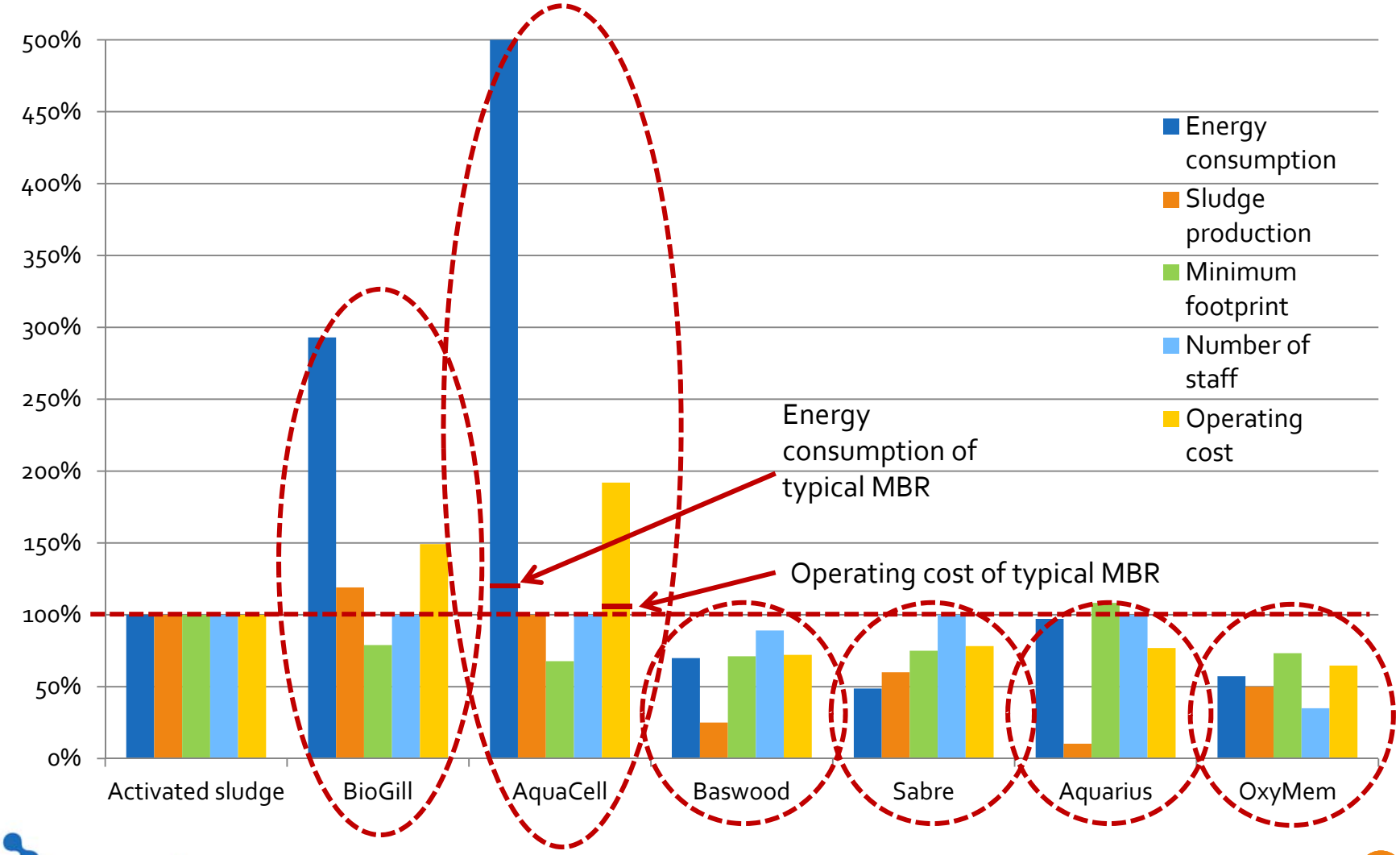
The next generation of secondary wastewater treatment



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Most promising current technologies

Emefcy

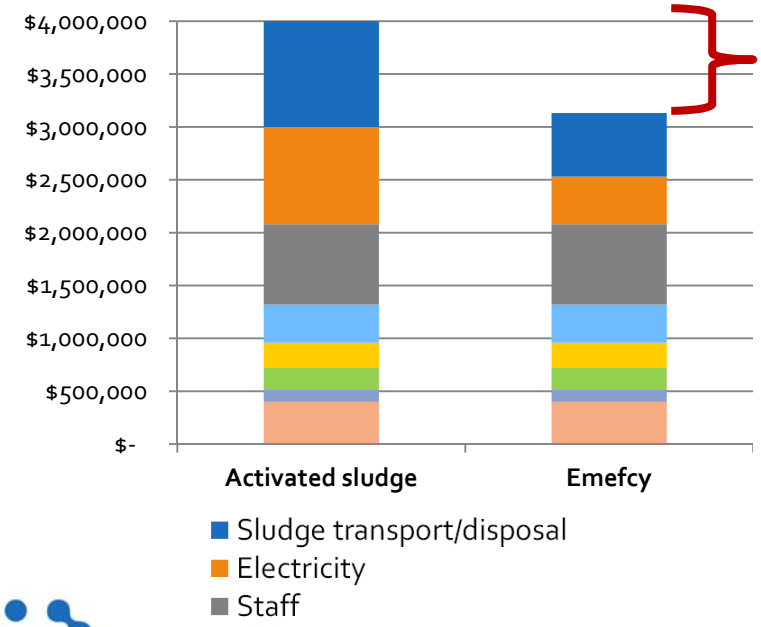
Lowest electricity consumption

aquarius TECHNOLOGIES INC.

Least sludge

OXYMEM Baswood

Smallest staff



Over $800,000 in operating costs savings per year from a combination of energy and sludge reduction

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Most promising current technologies

Lowest electricity consumption

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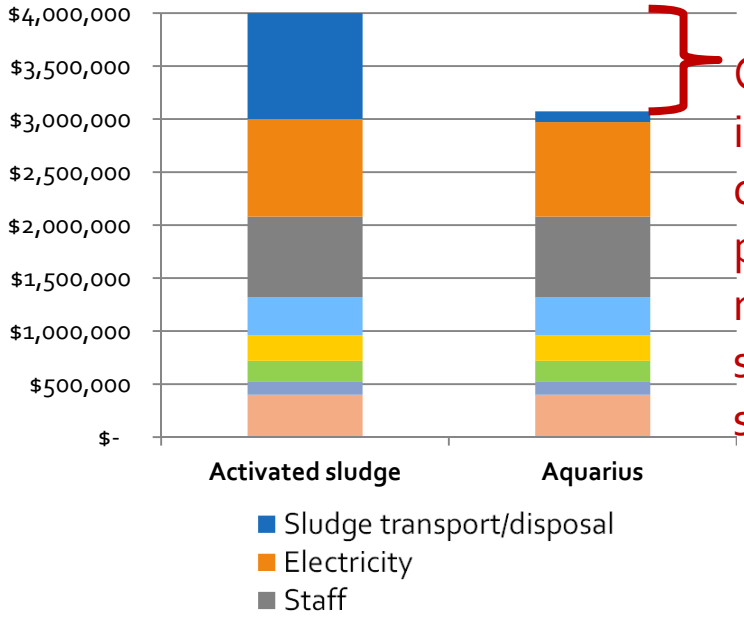


Over $900,000 in operating costs savings per year, mostly from savings on sludge disposal

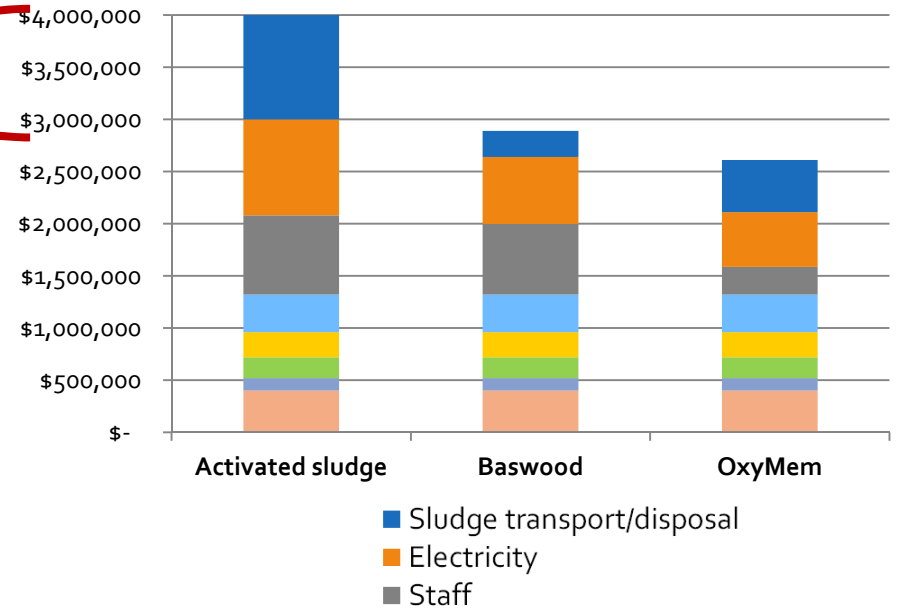
Most promising current technologies

Lowest electricity consumption

Least sludge

Smallest staff

Over $1 million in operating cost savings from staff reduction, sludge reduction, and energy savings



Questions?

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