

Aeration Technologies

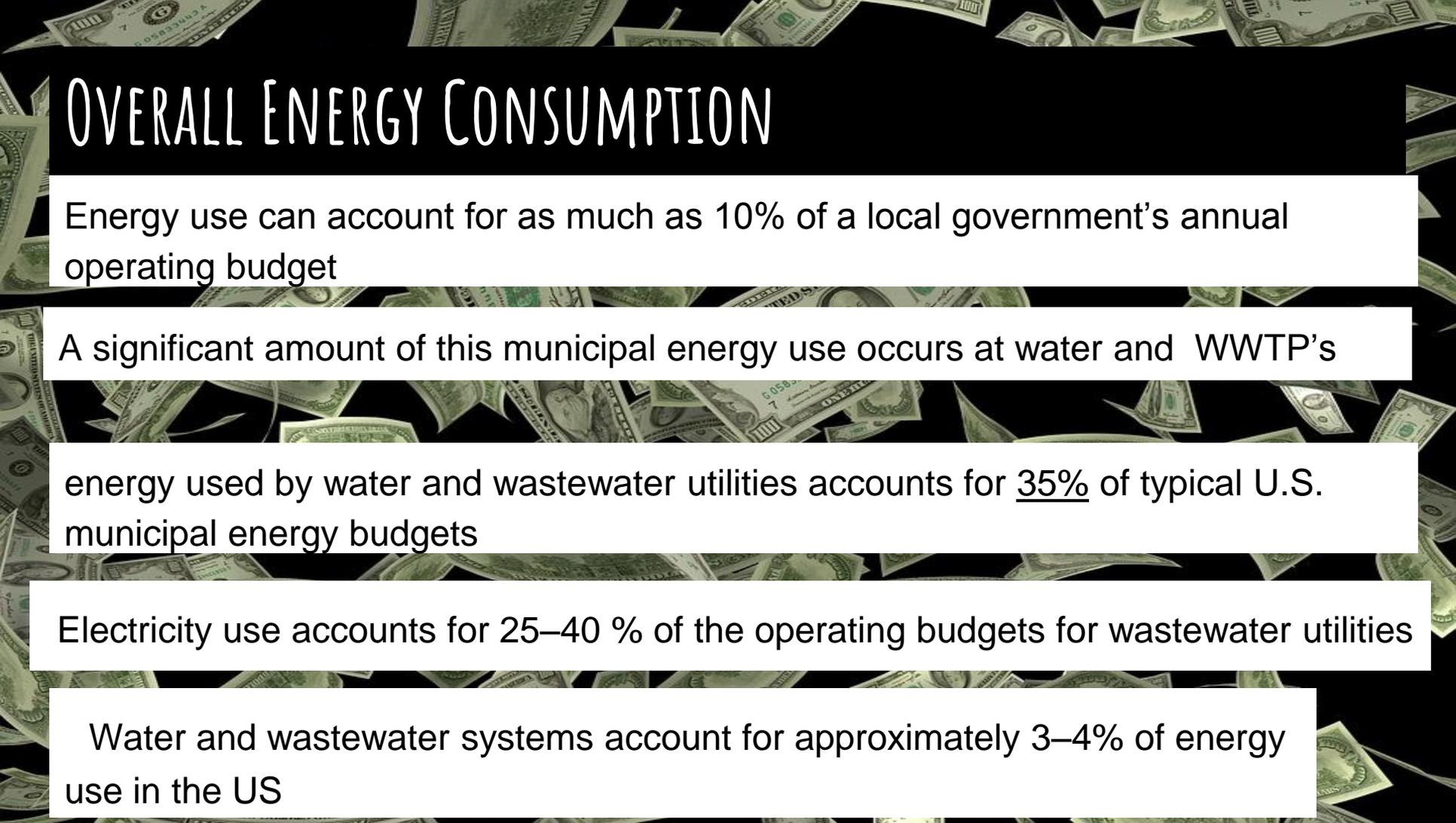
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LOCAL GOVERNMENT CLIMATE AND ENERGY STRATEGY GUIDES

Energy Efficiency in Water and Wastewater Facilities

A Guide to Developing and Implementing
Greenhouse Gas Reduction Programs



OVERALL ENERGY CONSUMPTION

Energy use can account for as much as 10% of a local government's annual operating budget

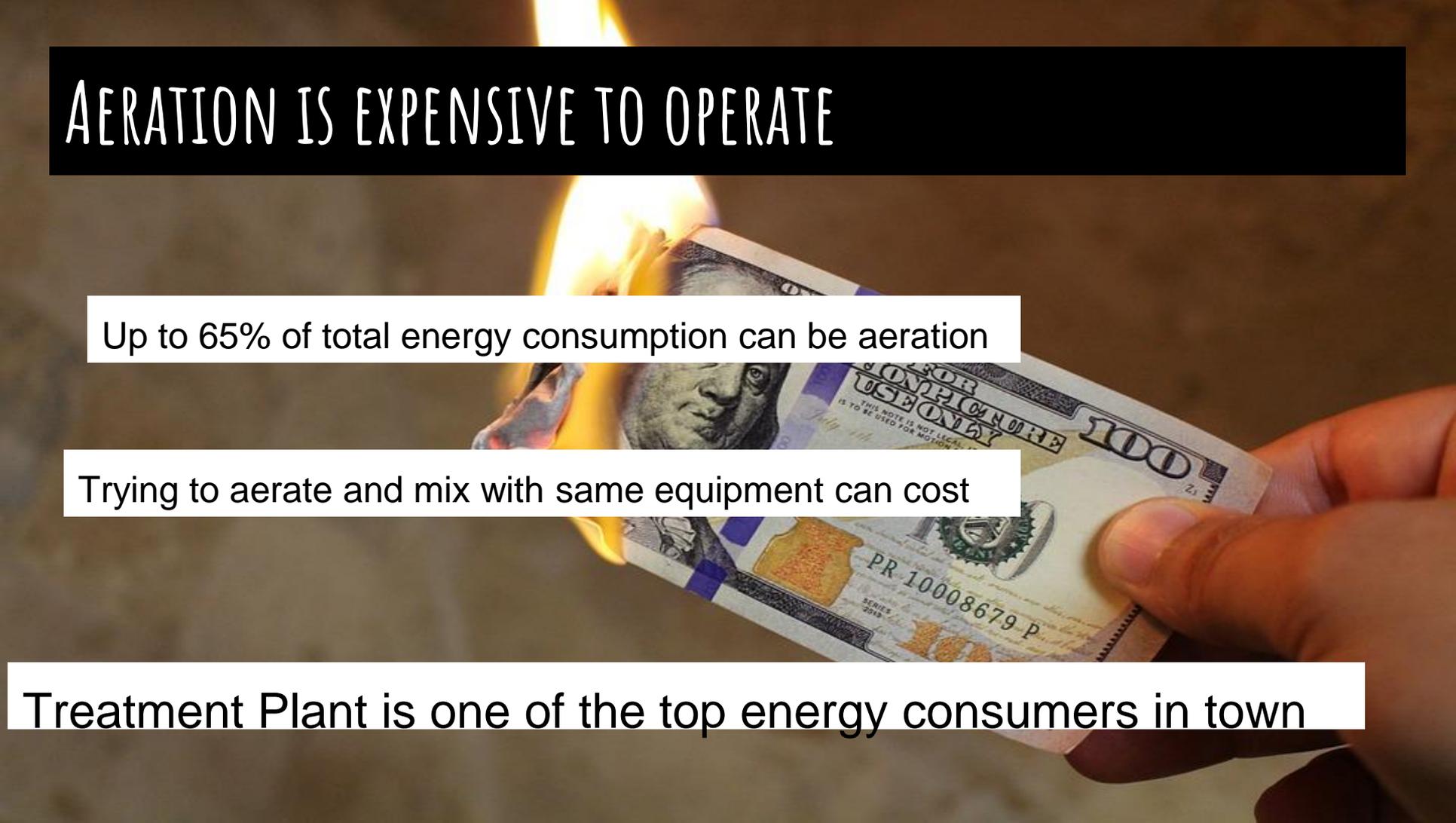
A significant amount of this municipal energy use occurs at water and WWTP's

energy used by water and wastewater utilities accounts for 35% of typical U.S. municipal energy budgets

Electricity use accounts for 25–40 % of the operating budgets for wastewater utilities

Water and wastewater systems account for approximately 3–4% of energy use in the US

AERATION IS EXPENSIVE TO OPERATE

A hand is holding a lit match over a 100 dollar bill that is being burned. The background is dark and blurry, focusing attention on the burning money.

Up to 65% of total energy consumption can be aeration

Trying to aerate and mix with same equipment can cost

Treatment Plant is one of the top energy consumers in town

WHERE IS IT USED?

EQ Basins

Aeration Basins

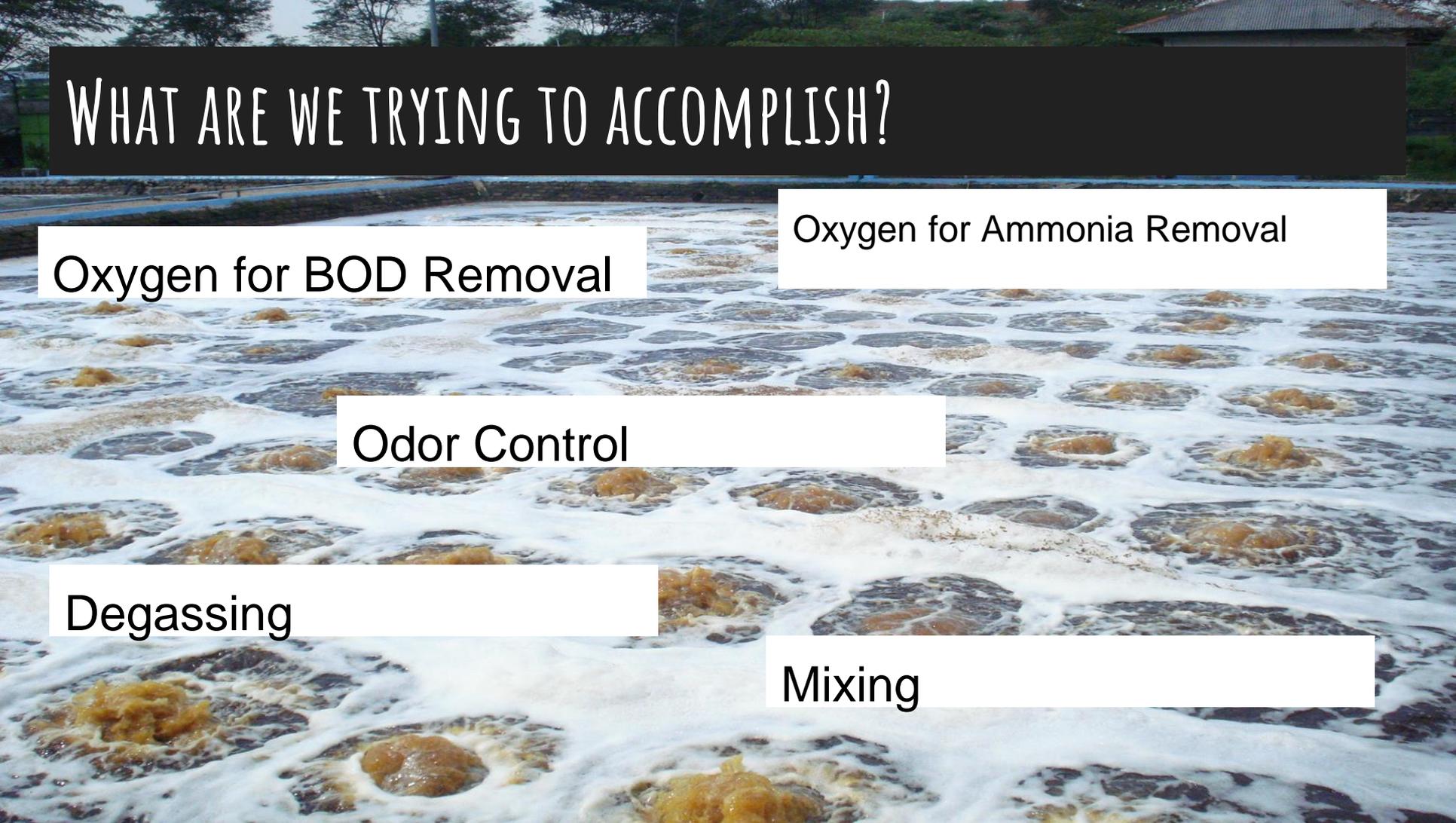
Aerobic Digesters

Lagoons

Others?



WHAT ARE WE TRYING TO ACCOMPLISH?

The background image shows a large-scale wastewater treatment process. It features a series of circular diffusers arranged in a grid, each creating a localized zone of intense aeration. The water is highly turbulent, resulting in a thick layer of white foam that covers the surface of the tank. The diffusers themselves are partially obscured by the foam and the churning water. The overall scene is one of active biological or chemical treatment.

Oxygen for BOD Removal

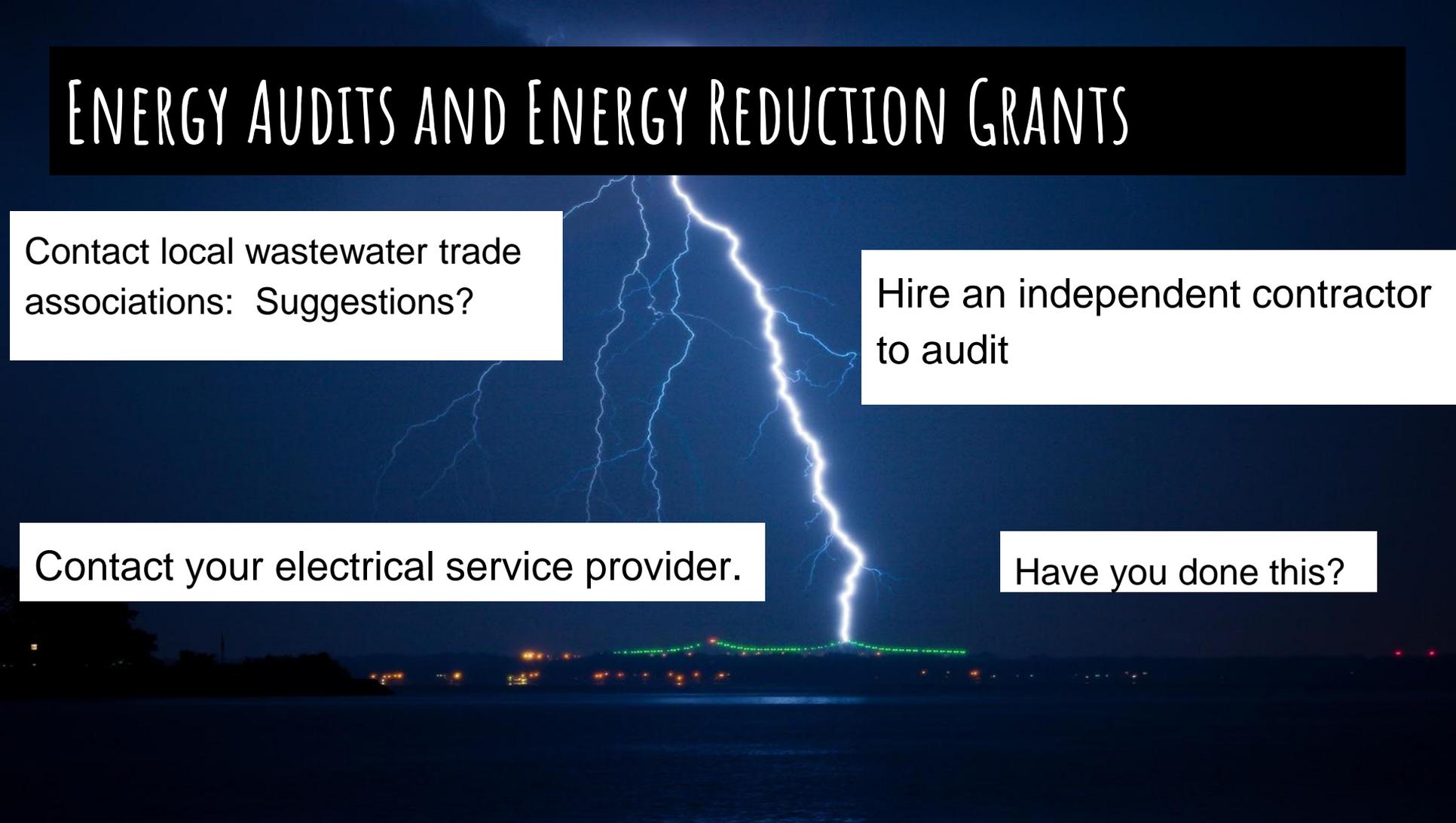
Oxygen for Ammonia Removal

Odor Control

Degassing

Mixing

ENERGY AUDITS AND ENERGY REDUCTION GRANTS



Contact local wastewater trade associations: Suggestions?

Hire an independent contractor to audit

Contact your electrical service provider.

Have you done this?

POSSIBLE AUDIT AVENUE WITH FIRSTENERGY



Commercial and Industrial
Energy Efficiency Programs

FirstEnergy[®]

Ohio Edison • The Illuminating Company • Toledo Edison

Lighting Programs

HVAC & Appliances

Specialty Programs

Program Allies

FACILITY AUDIT INCENTIVE PROGRAM

Learn more about cash incentive programs that provide reimbursement for facility audits.



DUKE SMART \$AVER

How it Works



1

Apply

You submit your application and savings calculations.



2

Receive an offer

We'll evaluate your application within four to six weeks and send you a preliminary incentive offer.



3

Install

You have up to one year to install the project.



4

Get paid

It takes up to four weeks for Duke Energy to evaluate your installation and process the incentive payment.

Smart \$aver Custom Incentives range from 25 to 150 percent of the project's annual electric savings. The simple payback time must be greater than one year after applying for the incentive and cannot exceed 50 percent of the incremental project costs for customers in Indiana, or 75 percent for customers in Kentucky, Ohio and the Carolinas.

START WITH THE EASIEST FIRST...EQ BASINS

Flow Equalization Basins (EQ Basins)

Not looking for full treatment

Often overlooked

Should Focus on
mixing

Degassing for Algae
Control

Same technology and equipment
as aeration basin

HOW MUCH OXYGEN

Pounds of Oxygen to Remove BOD and Ammonia

Many factors contribute, such as sludge age, temp., etc.

1.0-1.2 Pounds of Oxygen per Pound of BOD

4.6 Pounds of Oxygen per Pound of
Ammonia

OXYGEN REQUIREMENT EXAMPLE .200 MGD PLANT

Aerator Loading = Flow(MGD)x mg/l x 8.34

BOD = .200 MGD x 350 mg/l x 8.34 = 584 lbs/BOD

BOD = 1.2 lbs O₂ x 584 lbs = 700 lbs of O₂/Day

Ammonia = .200 MGD x 35 mg/l x 8.34 = 58 lbs/Ammonia

Ammonia = 4.6 lbs O₂ x 58 lbs = 267 lbs of O₂/Day

OXYGEN REQUIREMENT EXAMPLE .200 MGD PLANT

Aerator Loading = Flow(MGD)x mg/l x 8.34

700 lbs O₂ BOD + 267 lbs O₂ Ammonia = 967 lbs O₂/day

967 lbs O₂/day / 24 hours = 41 pounds O₂ per Hour

STANDARD OXYGEN TRANSFER EFFICIENCY (SOTE)

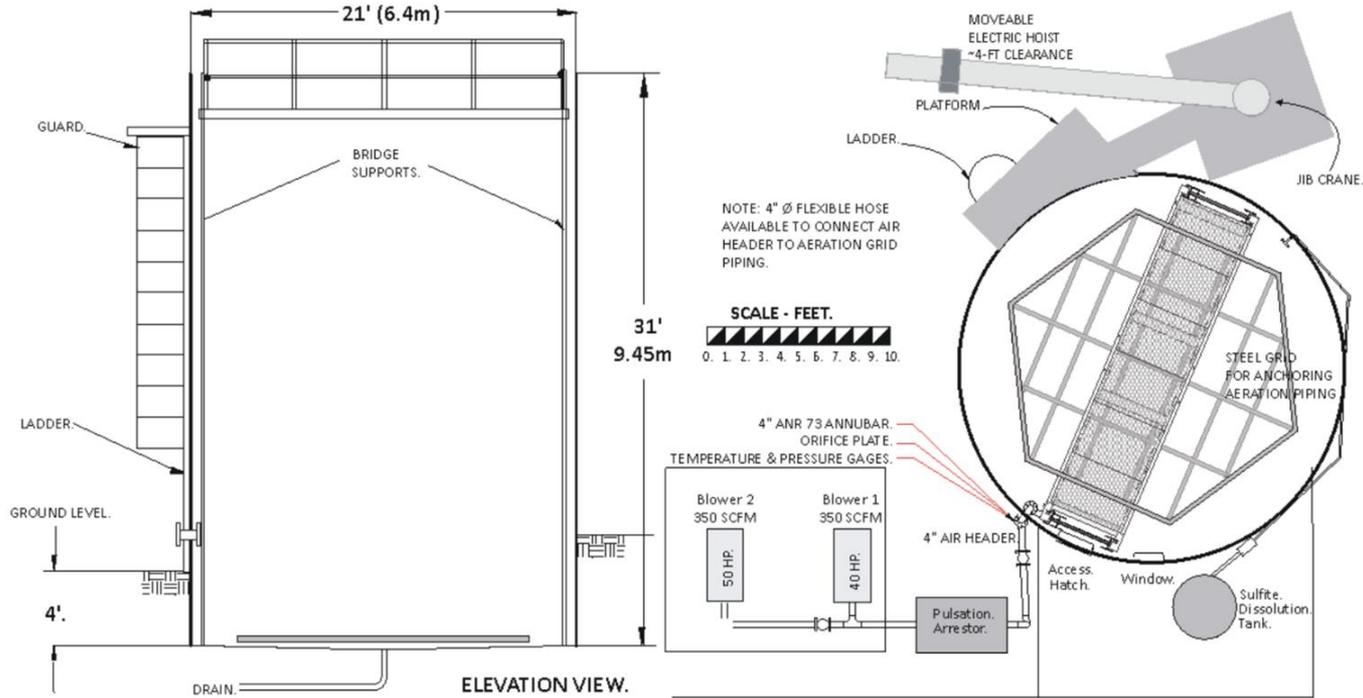
Conducted in a
ASCE Certified Lab

Chemicals used to deplete
O₂ from clean water

Aeration turned on and O₂ recharge
monitored by multiple probes

Gives industry standard to compare

TESTING FACILITY FOR OXYGEN TRANSFER



STANDARD OXYGEN TRANSFER EFFICIENCY (SOTE) RANGES

1.5 to 10 lbs O₂/BHP-Hour

Mechanical Surface Aerators

Coarse Bubble Diffusers

Jet Aerators/Aspirators

Fine Bubble Diffusers

MECHANICAL SURFACE MOUNTED AERATORS

Splash
Aerator



Surface Mixer Aerator



Mix water well horizontally, lower SOTE

MECHANICAL SURFACE MOUNTED AERATORS

Bradley ProFusion with Floats
and Sphere



Bradley ProFusion Removable Core

Deep water mixing, bubble contact chamber

COARSE BUBBLE DIFFUSERS



Good at Mixing,
Fair SOTE

FINE BUBBLE DIFFUSERS



FAir Mixing, good SOTE

DISTANCE CAN HURT, PLACE THE ENERGY WHERE IT IS NEEDED

Blower/Diffuser	Duty	Operational Horsepower
<u>Blower</u> 25 HP positive displacement rotary lobe blower with 90% efficiency motor for 640 CFM @ 6 PSIG 25 HP @ 50% efficiency = 12.5 HP	Boost ambient air for a discharge pressure of 6 PSIG	12.5 HP
<u>Piping</u> High pressure piping system requiring 2.4 PSIG pressure loss for delivery of 640 CFM 40% x 12.5 HP to transport air from blower to diffuser = 5 HP	Deliver high pressure air from blower to diffuser	5 HP
<u>Diffuser</u> Fine bubble diffuser to an oxygen aeration and mix the waste sludge 60% x 12.5 HP for aeration/mixing	Injection of small air bubbles in waste sludge for aeration and agitation	7.5 HP

OXYGEN IS IMPORTANT, BUT SO IS MIXING

Keep solids in suspension

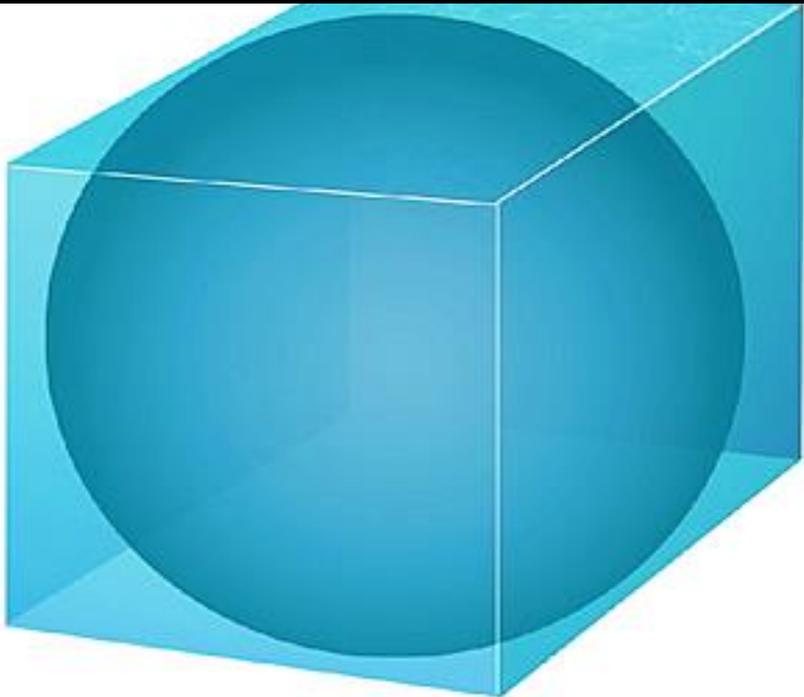
Odor control

Bring oxygen, pollutants
and bugs together

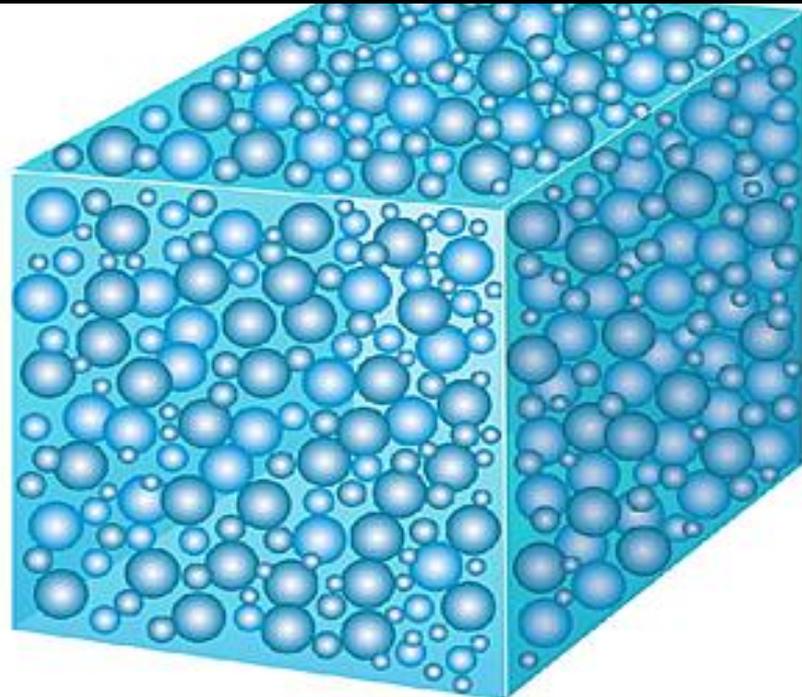
Decrease short-
circuiting

Must Consider vertical and Horizontal Mixing

DIFFERENT BUBBLES DIFFERENT JOBS



Moves Water,
Coarse Bubbles



Transfers Gas,
Fine Bubbles

COMBINING TECHNOLOGIES FOR IMPROVED EFFICIENCIES



Blade +
Diffusers



Fine +
Coarse
Bubble



Fine bubble
blade + jet prop

LAGOONS HAVE UNIQUE NEEDS & 5 COMMON ISSUES

A photograph of a lagoon with several floating aeration units. The units are rectangular metal platforms with a central white cylindrical motor. The water is calm, reflecting the sky and the bare trees on the far shore. The background is a dense line of leafless trees under a clear sky.

Short-Circuiting

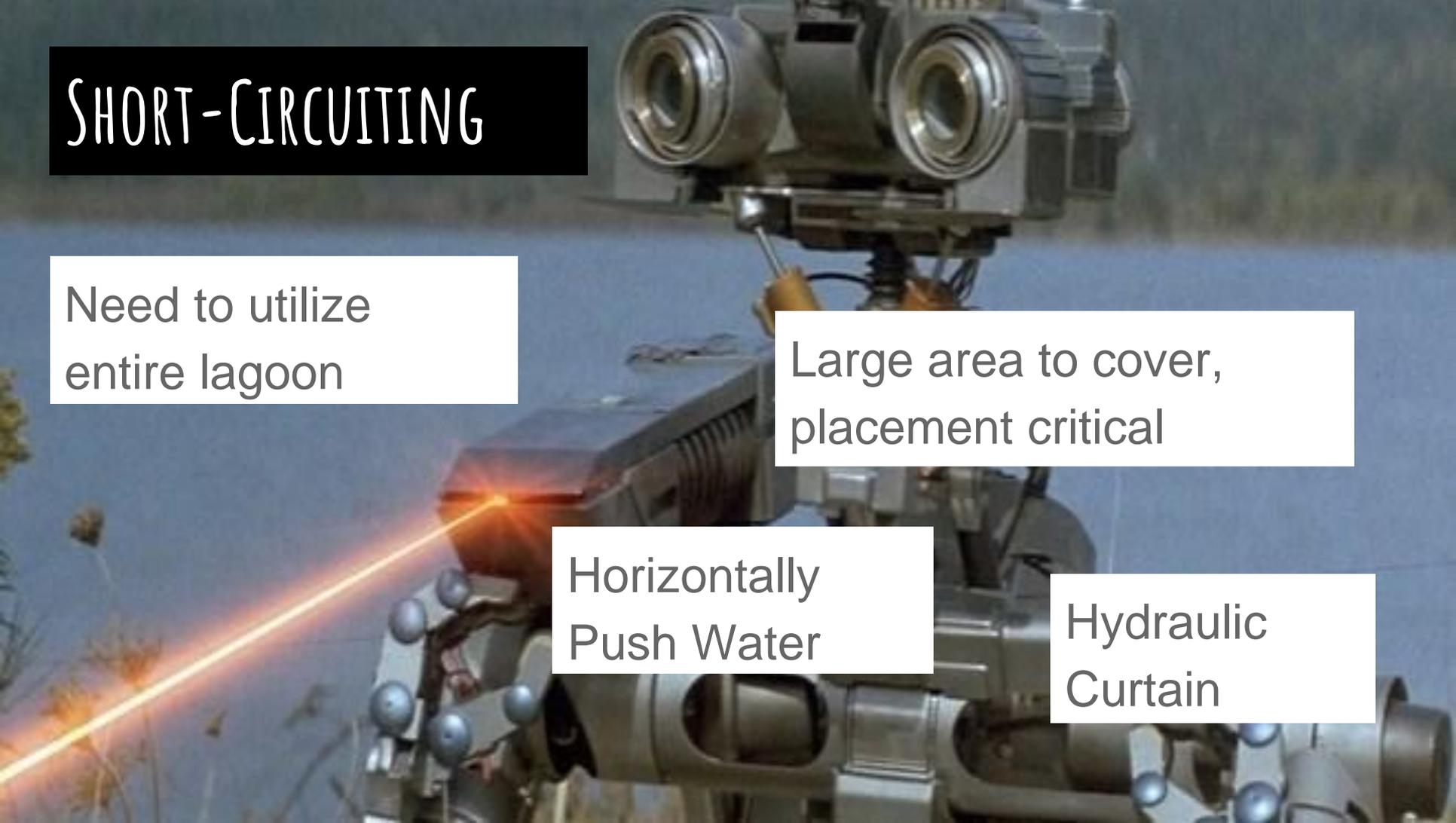
Insufficient Horizontal
and vertical mixing

Excessive Sludge

Highly Fluctuating O₂ Levels

Excessive Algae

SHORT-CIRCUITING



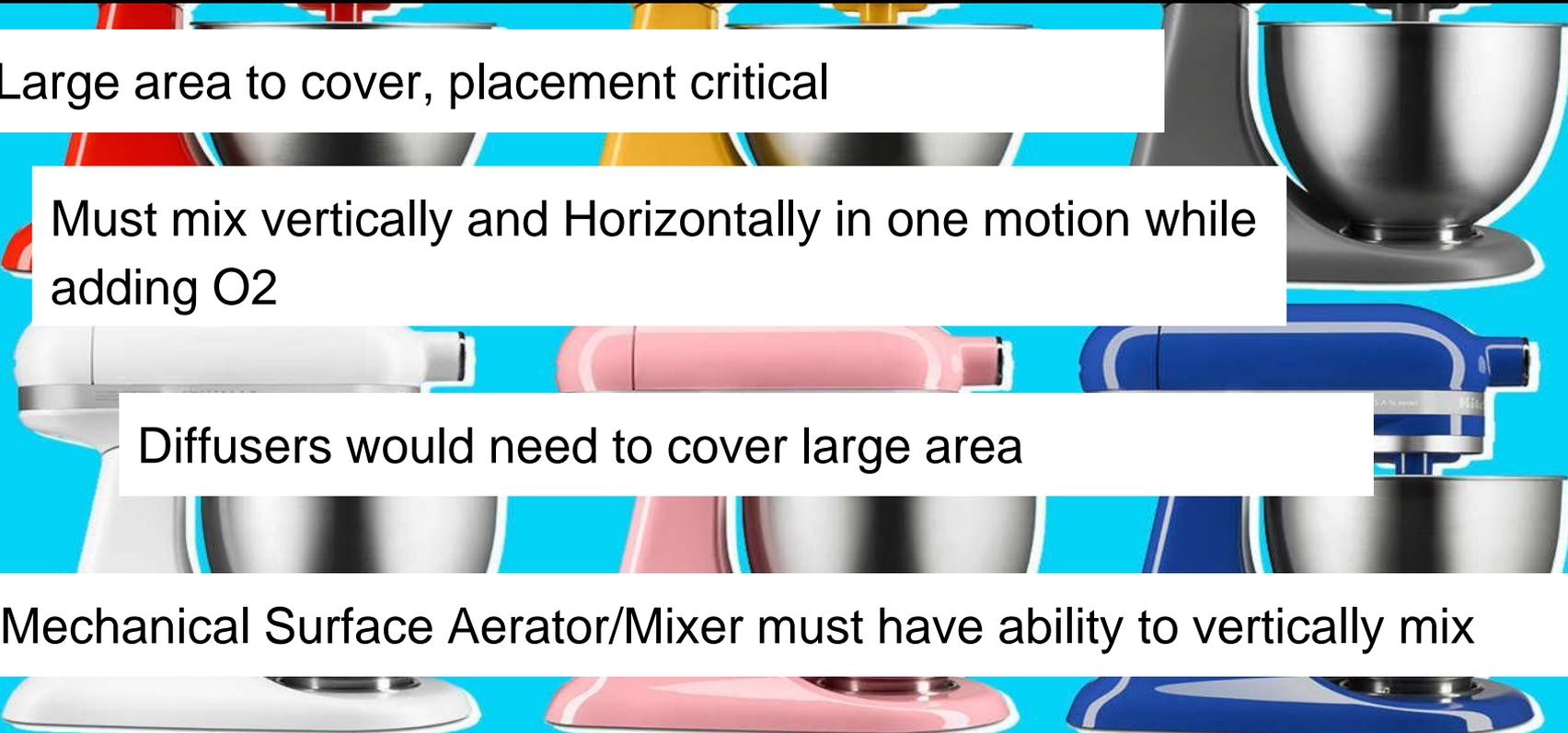
Need to utilize
entire lagoon

Large area to cover,
placement critical

Horizontally
Push Water

Hydraulic
Curtain

INSUFFICIENT HORIZONTAL & VERTICAL MIXING

The background of the slide features three mechanical surface aerators. On the left is a white one, in the center is a pink one, and on the right is a blue one. Each aerator has a stainless steel mixing bowl and a motor base. The aerators are shown from a side-on perspective, highlighting their design and the placement of the mixing bowl.

Large area to cover, placement critical

Must mix vertically and Horizontally in one motion while adding O₂

Diffusers would need to cover large area

Mechanical Surface Aerator/Mixer must have ability to vertically mix

EXCESSIVE SLUDGE, MMMM

No solids handling like mechanical plant

Contributes to short-circuiting, BOD and capacity

Water and O₂ needs to flow over sudge layer for toxin flushing to digest

Can foul diffusers for loss of efficiencies

HIGHLY FLUCTUATING O₂ LEVELS

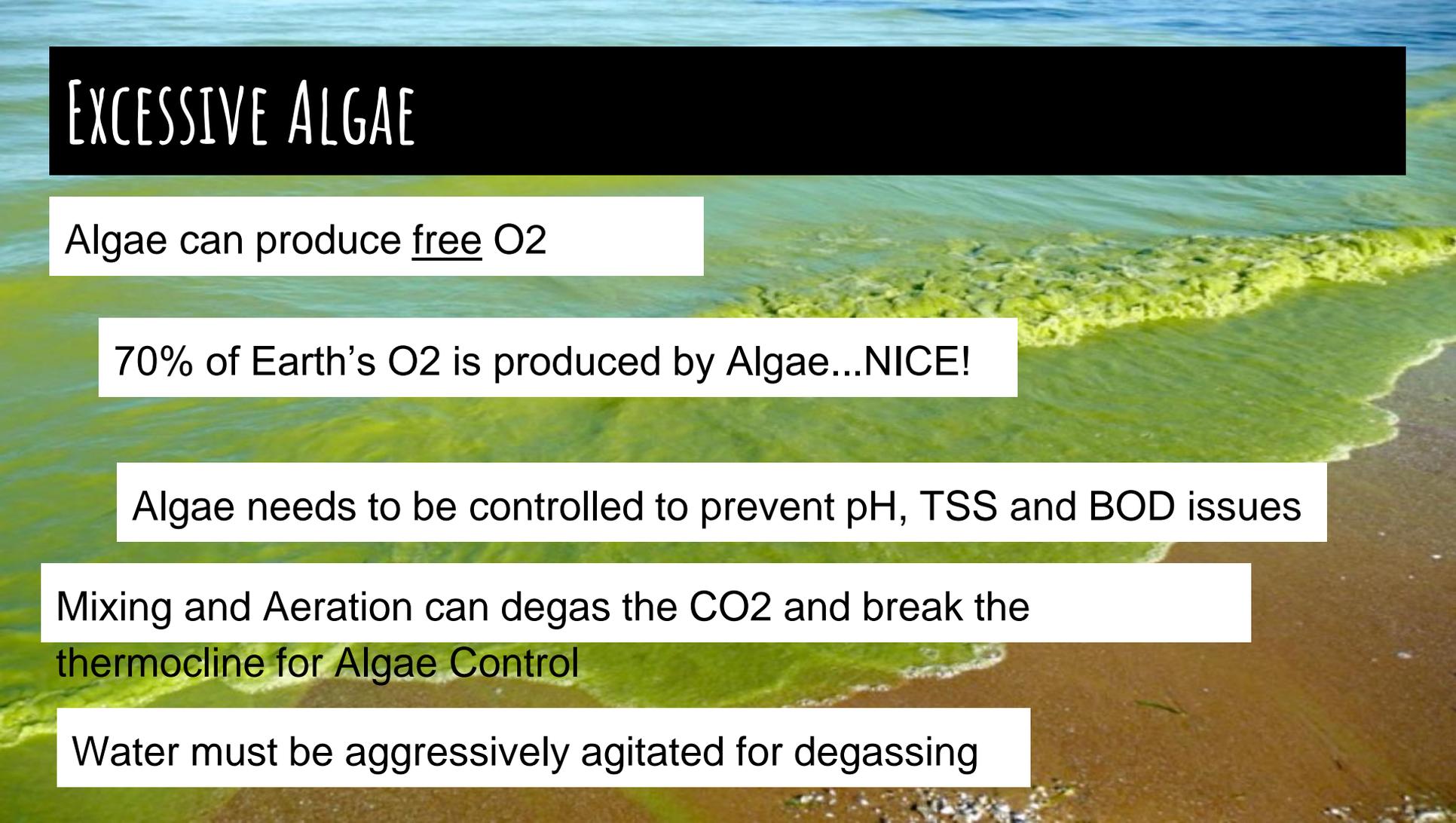
Needs to be evenly distributed over a large area

Algae can be the cause

Needs to be balanced for a healthy ecosystem



EXCESSIVE ALGAE

The background of the slide is a photograph of a beach. The water is a vibrant green color, indicating a high concentration of algae. The waves are breaking onto a sandy beach. The sky is not visible, but the water transitions from a deep blue-green to a lighter, more yellowish-green near the shore.

Algae can produce free O₂

70% of Earth's O₂ is produced by Algae...NICE!

Algae needs to be controlled to prevent pH, TSS and BOD issues

Mixing and Aeration can degas the CO₂ and break the thermocline for Algae Control

Water must be aggressively agitated for degassing

OTHER ALTERNATIVES THAT COULD HELP

Improved Headworks to remove extra organics

SCADA System for better control

MBBR requires less mixing power

Additional monitoring points throughout

Variable Frequency Drives

Other suggestions?

Consistent Maintenance plan



smart infrastructure

Bradley Lagoon Enhancement Products

Bradley Aeration/Mixing

AUC Mechanical Treatment Plants

Aquionics UV Disinfection

Rehau Municipex Water Distribution

eOne Grinder Pump Collection