Establish a baseline for energy use, and explore the interplay that pumping and chilling have on the aquarium's environmental performance and improve animal welfare.

**Research Question**

How can we improve the Aquarium’s environmental performance in a cost-effective way while meeting the needs of the marine animals?

**Objectives**

- Establish a baseline for energy use, CO2 emissions, and biological health
- Identify new methods and processes to reduce environmental impacts and improve animal welfare
- Assess economic feasibility of a variety of improvement options

**Methods**

- Alternative Technology
- Animal Mortality
- System Head
- Pumping and Cooling Equipment and Practices
- Cost Benefit analysis

**Results**

**Background**

Located on San Francisco’s Pier 39, Aquarium of the Bay (AOTB) is a non-profit dedicated to the conservation of the San Francisco Bay and its watershed. The 600,000 visitors who come annually view stunning displays of life below the surface in two underwater tunnels and jellyfish, tropical, and other sea life exhibits.

AOTB earned certification as a San Francisco Green Business in 2005. However, this certification only addressed the aquarium’s sustainability. To fulfill the requirement set forth by our research question, improving the Aquarium’s environmental performance in a cost-effective way while meeting the needs of the marine animals, we recommend that the aquarium implement the following scenarios:

**Scenario 1 (Carbon Focused)**

Goal: minimize AOTB’s greenhouse gas emissions

**Includes**

- Water Cooling
- 1) Insulation
- 2) Fan
- 3) Power Conditioners
- 4) Demand Response Plan
- 5) Motor Replacement
- 6) CleanPowerSF

CleanPowerSF is an energy provider that offers a renewable alternative to PG&E.

**Scenario 2 (Animal Focused)**

Goal: improve animal welfare the greenest way possible

**Includes**

- Water Cooling
- 1) Insulation
- 2) Additional Chiller
- 3) Fan
- 4) Power Conditioners
- 5) Demand Response Plan
- 6) Motor Replacement
- 7) Variable Frequency Drive

**Scenario 3 (Balanced)**

Goal: improve animal welfare and aquarium sustainability in a cost-effective manner

**Includes**

- Water Cooling
- 1) Fan
- 2) Power Conditioners
- 3) Demand Response Plan
- 4) Motor Replacement
- 5) Variable Frequency Drive
- 6) No Sensitive Rockfish

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