

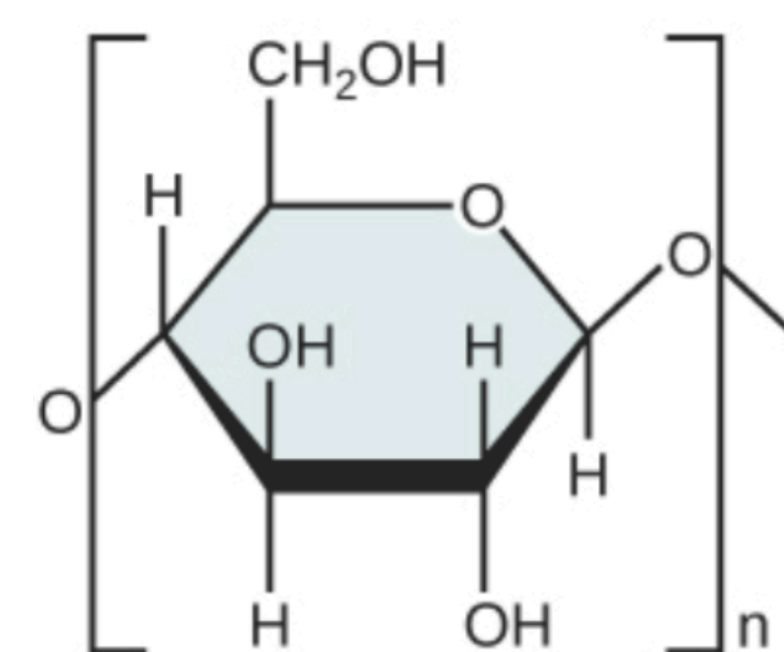


Background

Cotton is made of **cellulose**, which is formed from **glucose** monomer chains.

Blended textiles, such as polycotton, hinder conventional fibre recycling.

92 million tonnes of textiles per year are landfilled and incinerated globally, which wastes valuable resources.



Societal Impact

Circular Economy



Supports a circular economy through polyester recovery and cotton-to-glucose production.

Waste Diversion



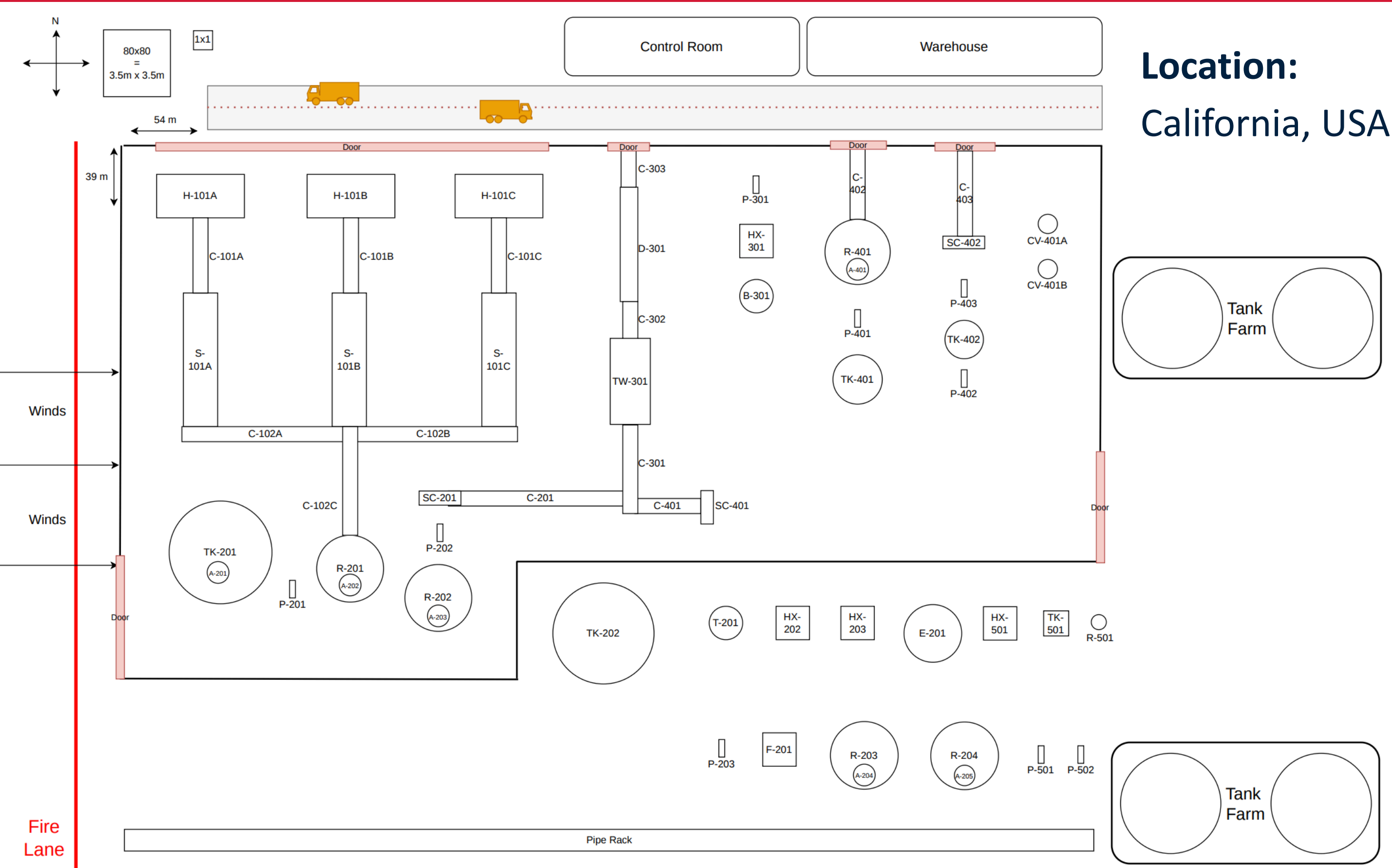
Diverts **50,000 tonnes** of textile waste from landfill, preventing **415,000 tonnes** of CO₂ per year.

Valuable Products



Creates **environmental and economic value** by turning low-value waste into useful products.

Plant Layout



Process Description

1. Textile Pre-Treatment



30/70 polycotton blend textile waste is mechanically cut to approximately 3x3 cm squares.

- Avoids clogging and fire hazards

2. Cellulose Dissolution Reaction

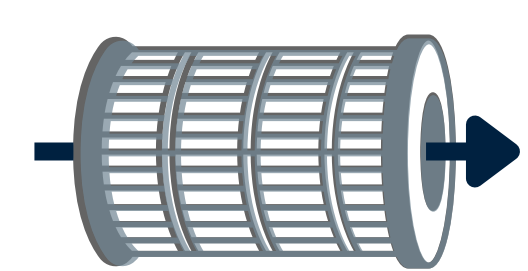


72wt% concentrated sulfuric acid is added to break down cellulose into reduced sugars.

Reactor Specifications:

- T: 40°C, P: 1 atm
- Residence Time: 30 mins

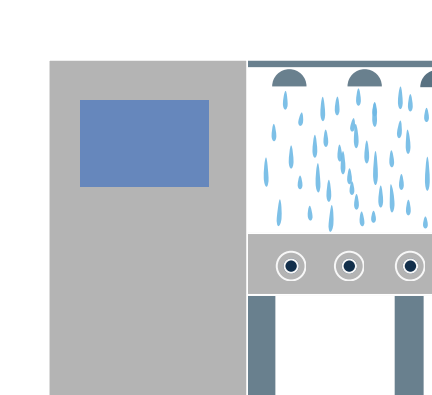
3a. Reduced Sugar Nanofiltration



Liquid-liquid separation between reduced sugar and sulfuric acid.

- Efficiency: 95%

3b. Polyester Recovery



Screened polyester enters tunnel washer and rotary drum.

Polyester is sold
(Total: 16,500 t/yr)

4. Cellulose Hydrolysis Reaction

5wt% dilute sulfuric acid hydrolyzes reduced sugars into glucose.

Reactor Specifications:

- T: 121°C, P: 3 atm
- Residence Time: 30 mins



5. Glucose-Acid Neutralization and Separation



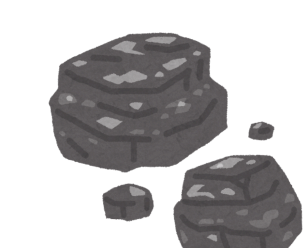
Calcium carbonate is added for neutralization, and the solid gypsum (calcium sulfate) is removed from the glucose solution.

Reactor Specifications:

- T: 40°C, P: 1 atm
- Residence Time: 5 mins

Calcium sulfate is sold
(Total: 51,200 t/yr)

6. Glucose Purification



Carbon adsorption for dye removal.

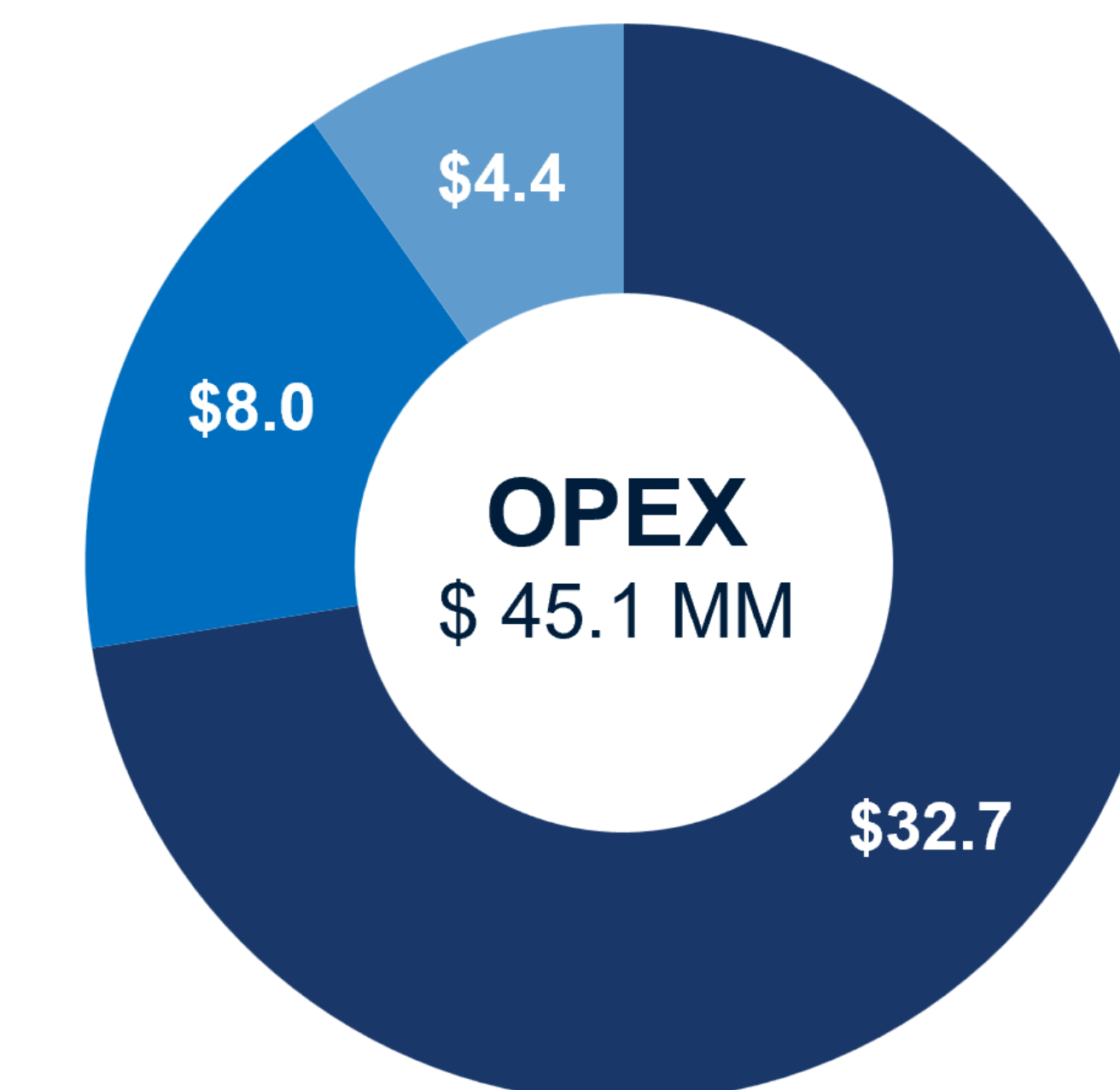
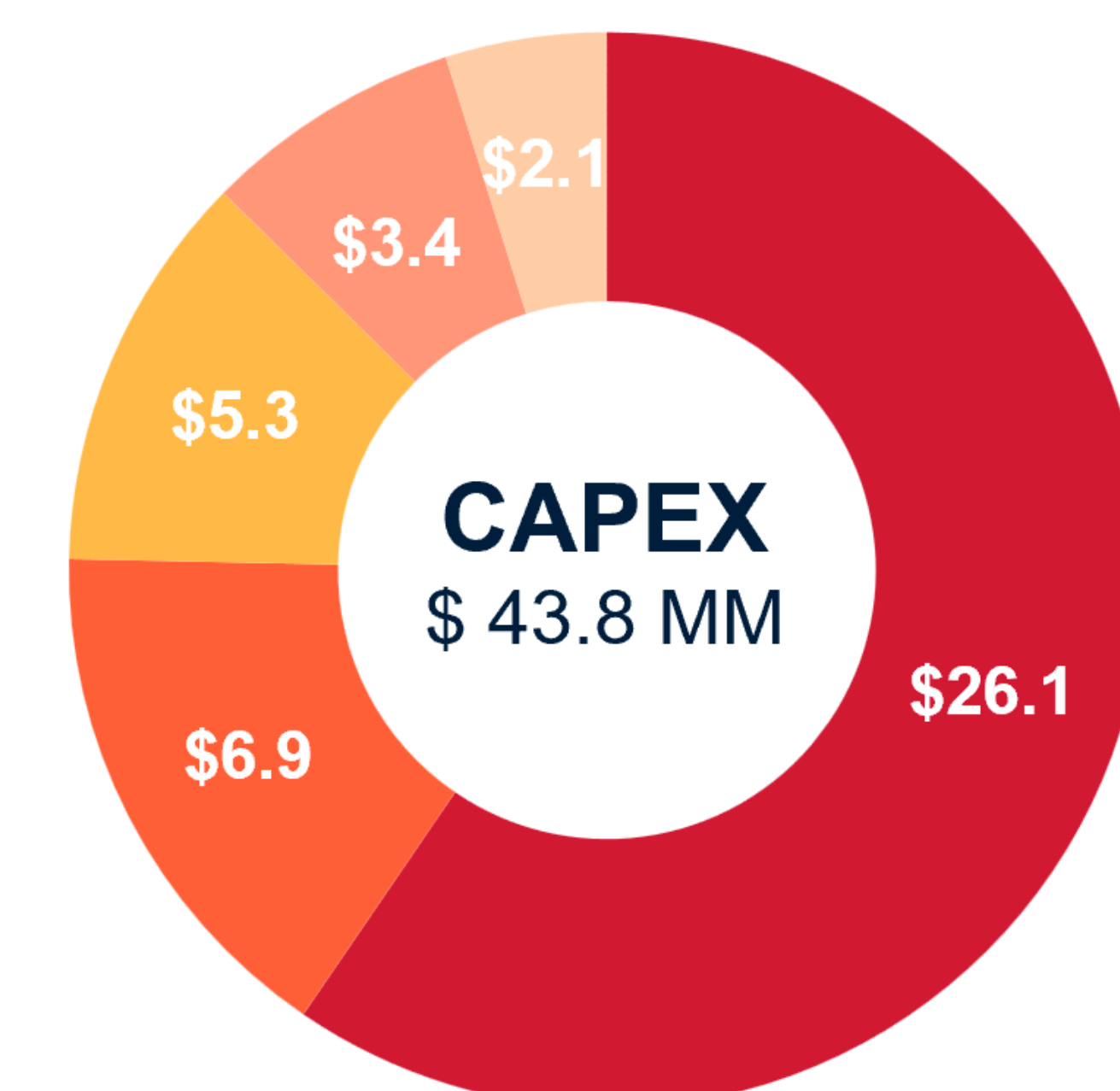
Liquid glucose is sold to neighbouring biorefineries and agricultural processes (Total: 94,500 t/yr)

Economics

Plant Construction:
2 years

Plant Lifetime:
25 years

Annual Operation:
320 days



■ Total Direct Costs
■ Working Capital
■ Total Indirect Costs
■ Contingency
■ Contractor's Fee

■ Direct Manufacturing Costs
■ General Expenses
■ Fixed Manufacturing Costs

Total Revenue
\$50.4MM

Glucose
\$22.0 MM

Polyester
\$24.8 MM

Gypsum
\$3.6 MM

Key Economic Indicators

Net Present Value: \$34 MM USD
Internal Rate of Return: 13%
Payback Period: 8 years
Break-Even Tipping Fee: \$73 USD/tonne

Environmental Impacts

Gas Emissions



CO₂: 16827 t/year
Emissions reported yearly to the California Air Resources Board.

Solid Waste



1497 kg activated carbon replaced every 2 months.
Spent carbon is disposed to hazardous waste facilities.

Wastewater



Water: 34335 t/year
Sugars: 492 t/year
Na₂SO₄: 14986 t/year
Effluent treated at a water treatment facility.