

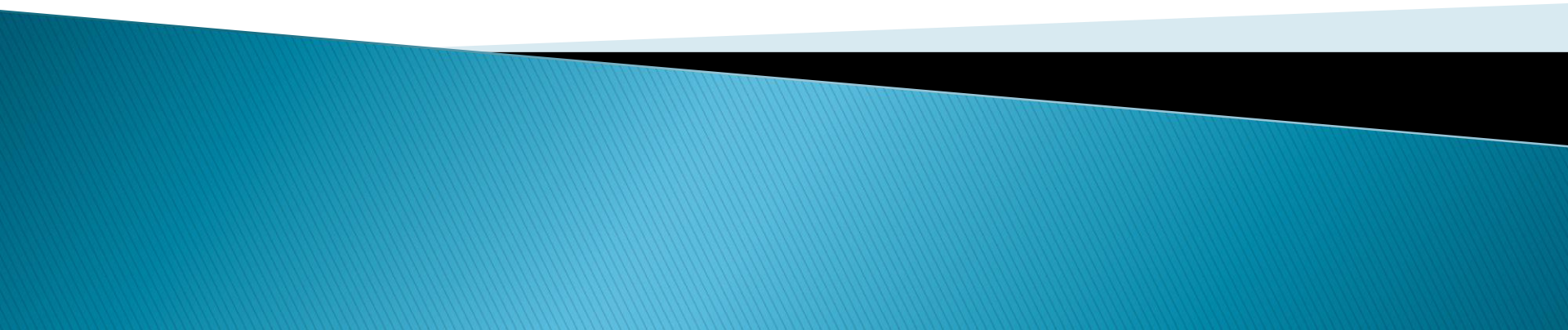
Operational Cost Considerations for Desalination



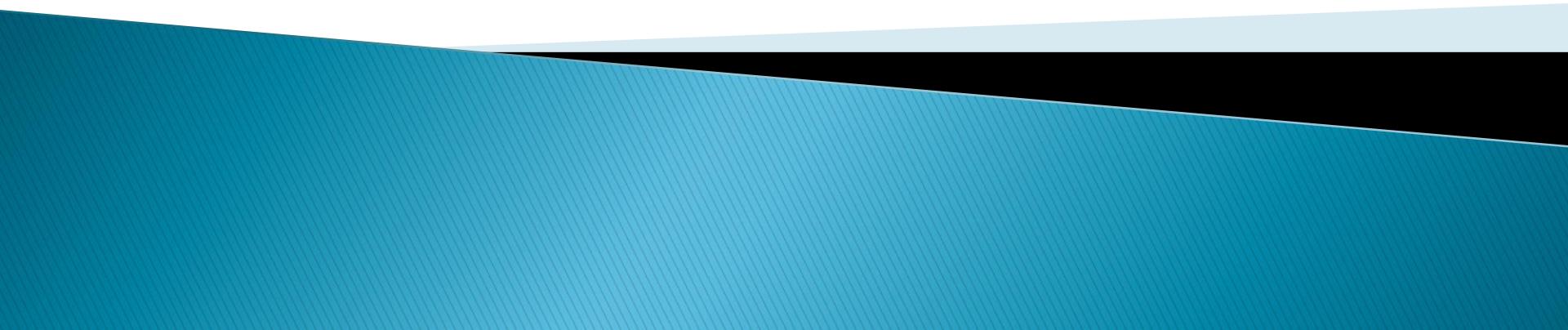
General Cost Categories

- Labor
- Materials
- Energy
- Other

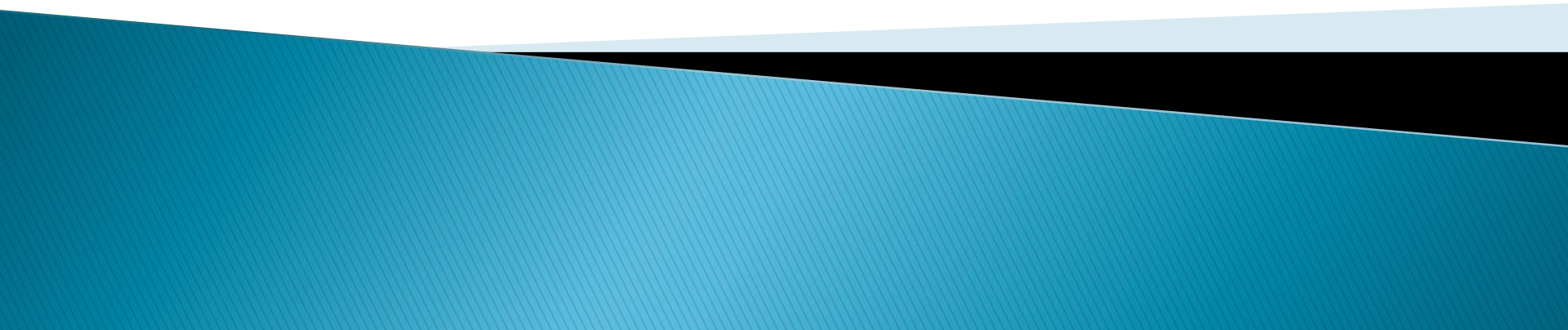
Plant Operators

- Record Keeping – 30 Minutes Daily
 - Filter Changes – 30 Minutes Every Two Months
 - Cleaning – 8 Hours Quarterly
 - Routine and Preventative Maintenance – 2 Hours Quarterly
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Materials

- Cartridge Filters
 - Membranes
 - Chemicals
 - Cleaning Chemicals
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Energy

- Feed Water/Well Pump(s)
 - High Pressure Booster Pump
 - Chemical Feed Pumps
 - High Service Pump(s)
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Other

- Discharge Permits
- Reject Disposal
- Property
- Buildings
- Financing
- Spares and Replacement Parts
- Office Personnel
- Field Personnel

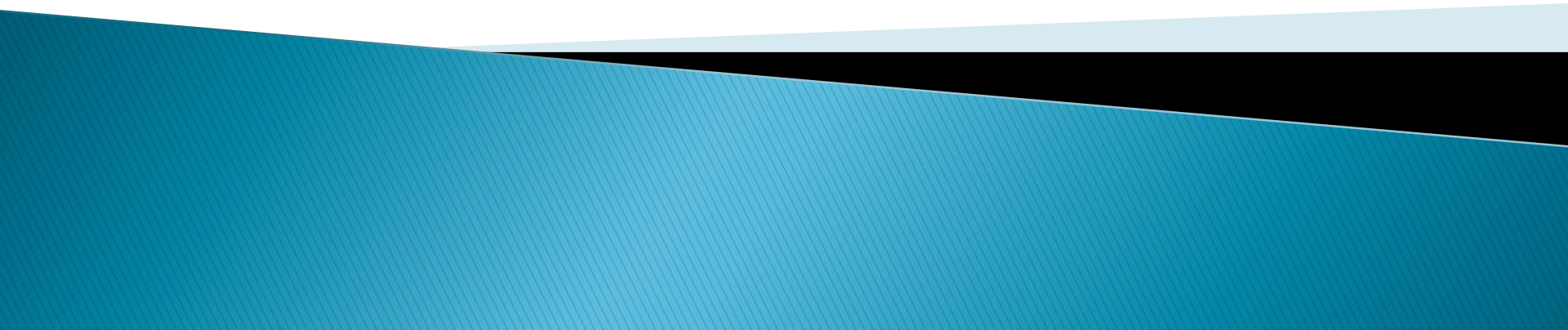
Salinity Levels

Brackish Water

- TDS up to 5000 mg/l
- Typically operates at pressures up to 300 psi
- Low Energy Brackish Water Membranes

Salinity Levels

High Brackish Water

- TDS 5000 – 16,000 mg/l
 - Typically operates at pressures up to 600 psi
 - Low Energy Brackish Water Membranes, Low Energy Seawater Membranes, or Hybrid Mix
 - Interstage Boost May Be Required – Turbo or Booster Pump
 - May Operate at Lower Recovery
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Salinity Levels

Seawater

- TDS Levels up to 45,000+ mg/l
- Typically operates at pressures up to 1200 psi
- Low Energy Low Energy Seawater Membranes
- Energy Recovery device is usually incorporated
- Operates at Lower Recovery
- May Not Require Antiscalant

Membrane Treatment Cost Overview

Equipment Cost for Nominal 1 mgd Capacity

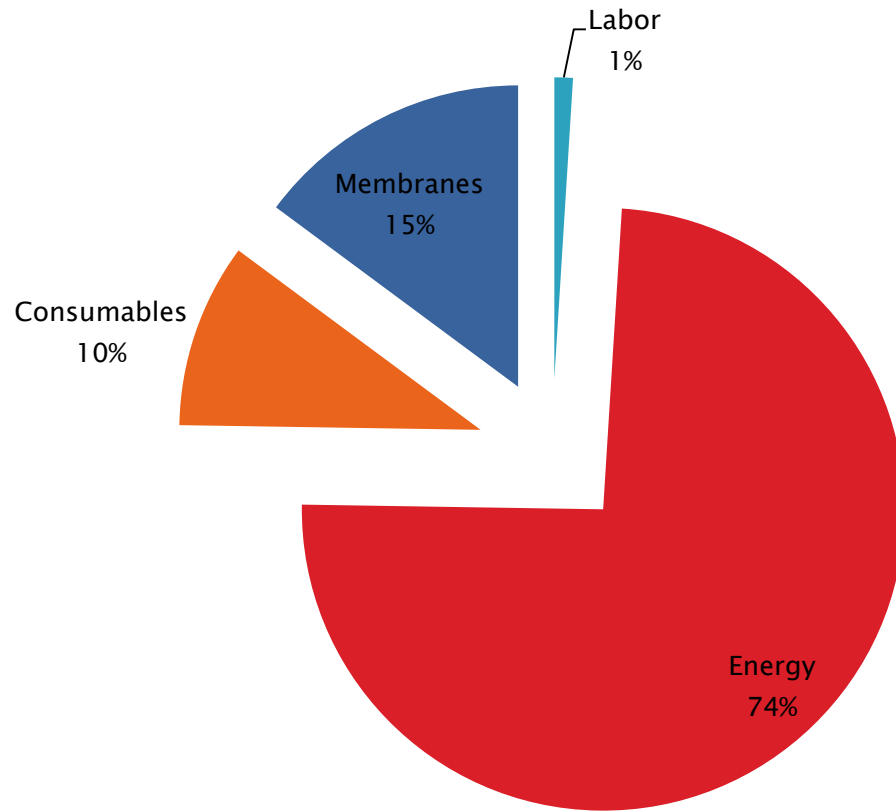
UF/MF	\$500-700k Membrane	\$150-200 Ancillary	\$1.6m Installed
RO Brackish	\$600-900 Membrane	\$250-350 Ancillary	\$2.0-2.5m Installed
RO Seawater	\$1.7-2.5m Membrane	\$300-400 Ancillary	\$3-4m Installed

Operating Costs

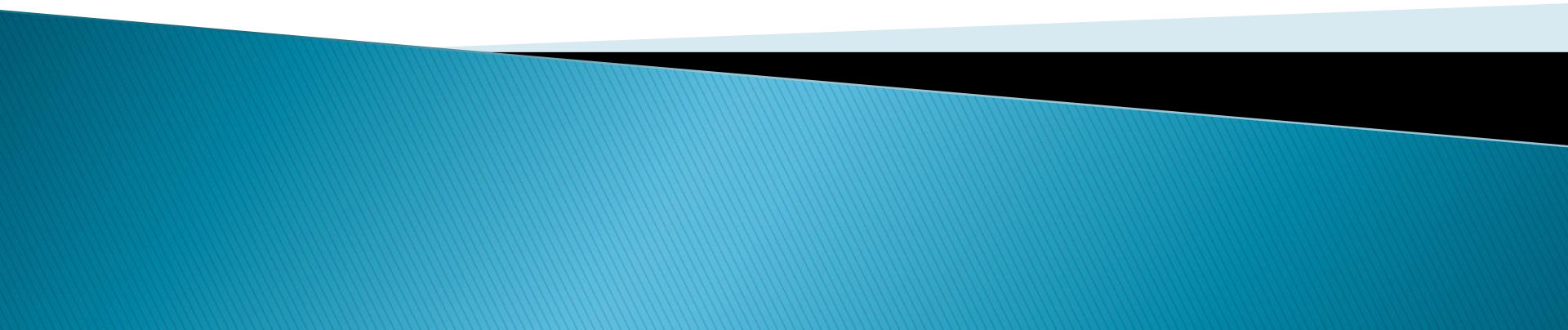
UF/MF	\$0.06 to 0.09/1000	Recovery 95%
RO Brackish	\$0.6 to 0.7/1000	Recovery 60 to 85%
RO Seawater	\$2.5 to 4.0/1000	Recovery 30 to 45%

- Majority of operating cost is energy and replacement membranes.
- Power at \$.10 kw/kwhr.
- Capital costs significantly affected by economies of scale.

Percentages

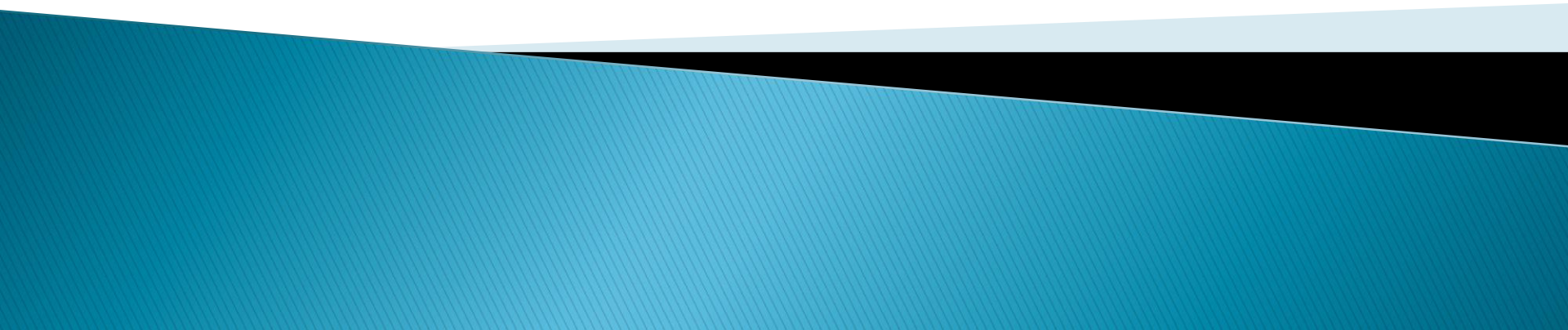


Scenario #1

- 500,000 gallons Per Day
 - 75% Recovery
 - 3000 ppm TDS
 - Low Energy Brackish Membranes
 - 15 GFD Flux Rate
 - 200 Foot Well Depth
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Item	Quantity	Frequency	Cost/Frequency	Cost/1000
Feed Energy	895.2 KW	Daily	\$ 89.52	\$ 0.1790
Booster Energy	1200 KW	Daily	\$ 120.00	\$ 0.2400
Prefilters	36 Each	2 Months	\$ 324.00	\$ 0.0110
Membranes	84 Each	5 Years	\$ 60,000.00	\$ 0.0660
Antiscalant	1 Gallon	Daily	\$ 12.75	\$ 0.0260
CIP Chemicals	1 Set	Quarterly	\$ 250.00	\$ 0.0060
			Total	\$ 0.5280

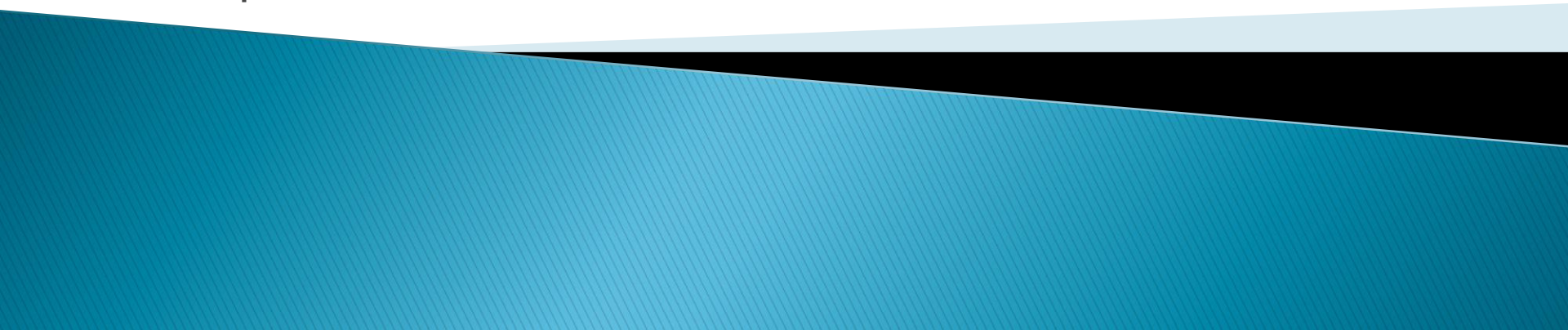
Scenario #2

- 500,000 gallons Per Day
 - 65% Recovery
 - 9000 ppm TDS
 - Hybrid Brackish and Seawater Membranes
 - Interstage Turbo Booster
 - 13 GFD Flux Rate
 - 200 Foot Well Depth
- 

Item	Quantity	Frequency	Cost/Frequency	Cost/1000
Feed Energy	1074 KW	Daily	\$ 107.40	\$ 0.2150
Booster Energy	2911 KW	Daily	\$ 291.10	\$ 0.5820
Prefilters	36 Each	2 Months	\$ 324.00	\$ 0.0110
Membranes	96 Each	5 Years	\$ 72,000.00	\$ 0.0790
Antiscalant	1.5 Gallon	Daily	\$ 19.13	\$ 0.0380
CIP Chemicals	1 Set	Quarterly	\$ 275.00	\$ 0.0060
			Total	\$ 0.9310

Scenario #3

Seawater Desalination

- 500,000 gallons Per Day
 - 45% Recovery
 - 36,000 ppm TDS
 - Low Energy Seawater Membranes
 - Turbo Charger Energy Recovery Device
 - < 10 GFD Flux Rate
 - Open Intake
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Item	Quantity	Frequency	Cost/Frequency	Cost/1000
Feed Energy	537 KW	Daily	\$ 53.70	\$ 0.1070
Booster Energy	6442 KW	Daily	\$ 644.20	\$ 1.2880
Prefilters	60 Each	1 Months	\$ 540.00	\$ 0.0360
Membranes	126 Each	5 Years	\$ 97,146.00	\$ 0.1060
Antiscalant	1 Gallon	Daily	\$ 12.75	\$ 0.0260
CIP Chemicals	1 Set	Quarterly	\$ 375.00	\$ 0.0060
			Total	\$ 1.5690

Project Overview

Unit set for economic evaluation	kgal-psi-gpm
System water production (gpm)	346.96
System recovery (%)	45.00

Project Economic Variables

Project Life (years)	20
Interest rate (%)	1
Power cost (\$/kWh)	0.1

Pass 1

Projection Results

Pass 1 permeate production (gpm)	346.96
Pass 1 feed pressure (psi)	850.98
Pass 1 concentrate pressure (psi)	830.46
Pass 1 recovery (%)	45.00
Pass 1 energy recovery efficiency (%)	

Capital Expense

Pass 1 pressure vessels	21
Pressure vessel cost (\$/vessel)	33333
Pass 1 capital for pressure vessels	\$699993.00
Product	SW30HRLE-400 (6)
Pass 1 total elements	126
Element cost (\$/element)	\$775.00
Pass 1 capital for elements (\$)	\$97650.00
Pass 1 capital (\$)	\$797643.00
Pass 1 capital(\$/kgal)	\$0.22

Operating Expense

Power

Pass 1 pumping power (kW)	356.87
Pass 1 pump specific energy (kWh/kgal)	17.14
Brine energy recovery (kWh/kgal)	0.00
Pass 1 net energy consumption (KWh/kgal)	17.14
Pass 1 net energy cost (\$/year)	\$312617.04
Energy expense NPV (\$)	5641347.29
Pass 1 energy expense (\$/kgal)	\$1.71

Membrane replacement cost

Pass 1 replacement rate (%/year)	18
Replacement price (\$/element)	\$775.00
Pass 1 replacement cost for elements (\$/year)	\$17577.00
Pass 1 replacement membrane NPV (\$)	\$317186.68
Pass 1 membrane replacement expense (\$/kgal)	\$0.10

Operating expense subtotal

Pass 1 operating expense NPV (\$)	\$5958533.98
Pass 1 operating expense per kgal	\$1.81

Pass 1 Total

Pass 1 cost NPV (\$)	\$97650.00
Life Cycle Cost (\$/kgal)	\$0.03

Total System

Capital	\$797643.00
Operating expense NPV (\$)	\$5958533.98
Cost of water NPV (\$/kgal)	\$1.85

Questions?

