IDEA Annual Conference

How Do You Reduce Potable Water Use by 50M Gallons per Year?

Presented by:
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Energy Center San Francisco, LLC

Clearway Energy
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Agenda

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How Much is 80 Million Gallons?

- Enough Water to Fill the Largest Oil Tanker that Can Go Through the Suez Canal
- Over 1,000 Miles of 55-gal Drums Lying End-to-End
- The Combined Annual Wine Production of New York and Washington

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The Setup

- 30 Mgal of nuisance ground water flows annually into the local subway stations and is disposed of into the City Sewer.
- The local District Energy System, Energy Center San Francisco (ECSF), is one of the largest potable water users in San Francisco with an annual water consumption of 100 Mgal.
- ECSF's cost for water/sewer has increase by 8x over the last 15 years.
- The City of San Francisco is aggressively trying to reduce potable water usage to conserve natural resources.

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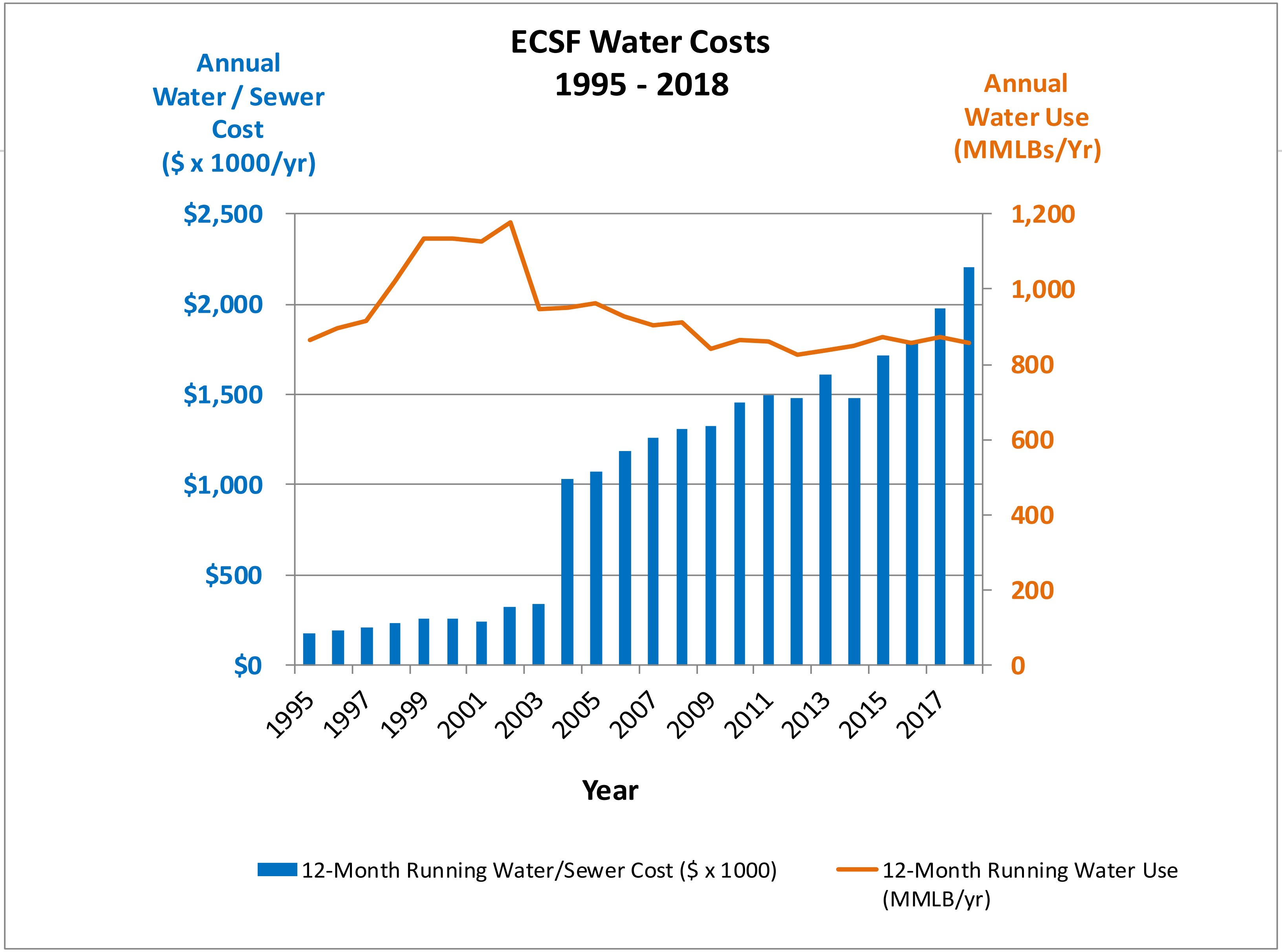

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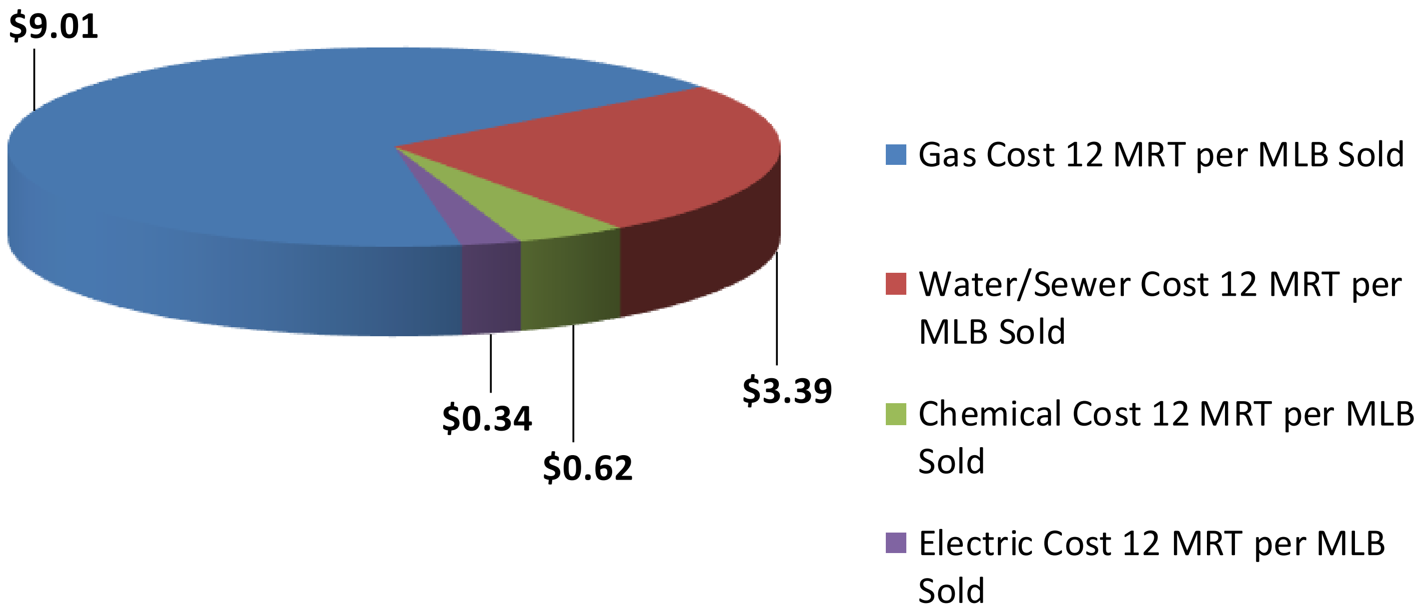
Steam Cost of Sales
(as of Jan 2019)
$13.36/MLB Sold



NOTE: 12 MRT = 12-Month Running Total

The Opportunity

- The Powell St. Subway Station is 2 blocks from ECSF and disposes of 30 Mgal of ground water intrusion per year.
- The San Francisco Public Utilities Commission is aggressively looking for large, water reuse projects and is offering up to $500k grants to bring them about.
- Is there a way to bring the needs of Public and Private entities together to create a solution that is a win for everyone?

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The Opportunity

- Engage SFPUC, the various Subway entities, and ECSF in Project collaboration process.
- Recover/treat 30 million gallons annually of ground water from the subway station.
- Install the first production well permitted in decades in San Francisco at ECSF site to enhance project economics.
- Reduce ECSF potable water usage by 80%.
- Convert from 90% makeup in 2016 to 0% water makeup by 2026.
- Potential Project Payback, less than 3 years.

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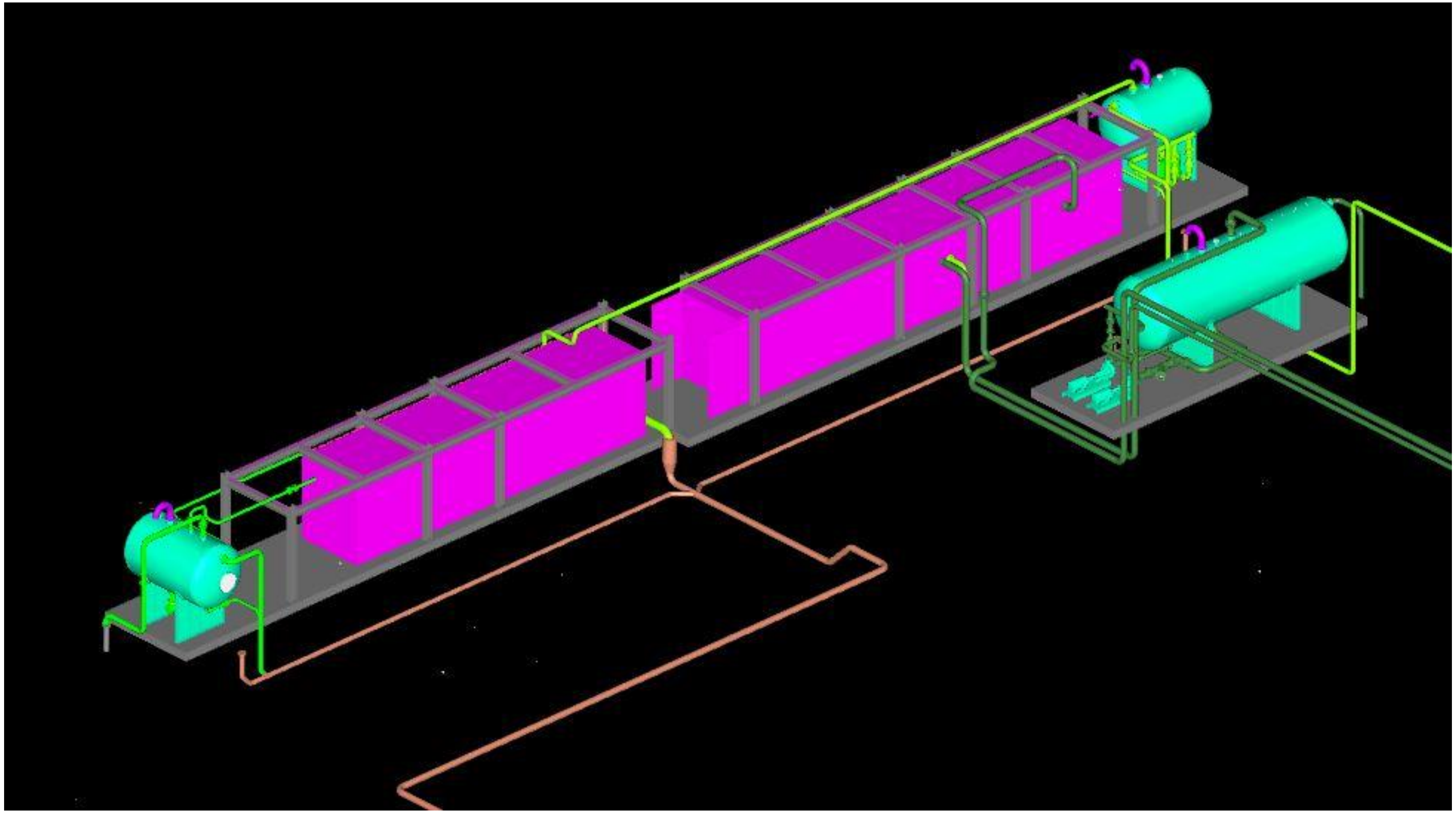
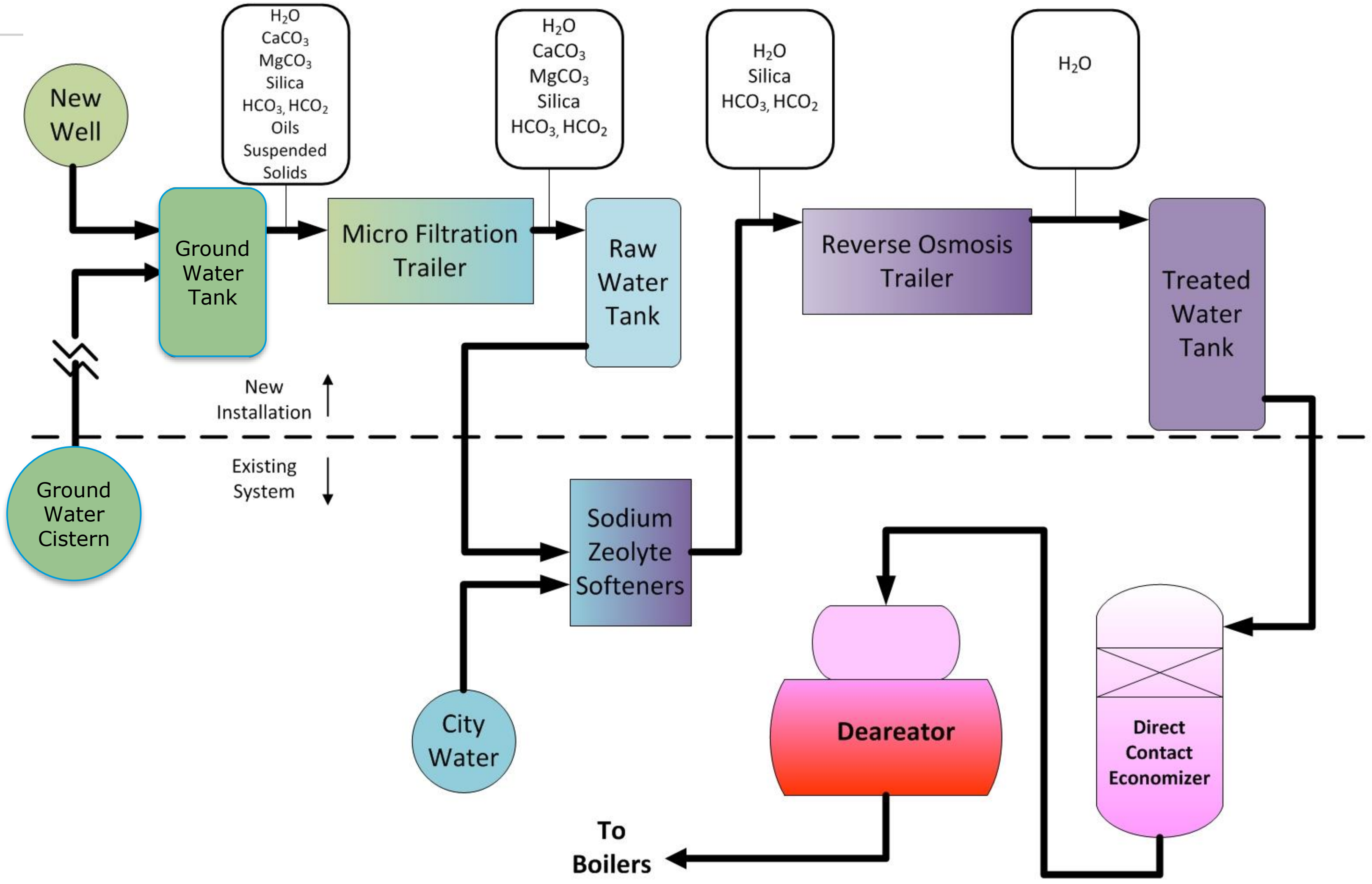
The Design



The Design



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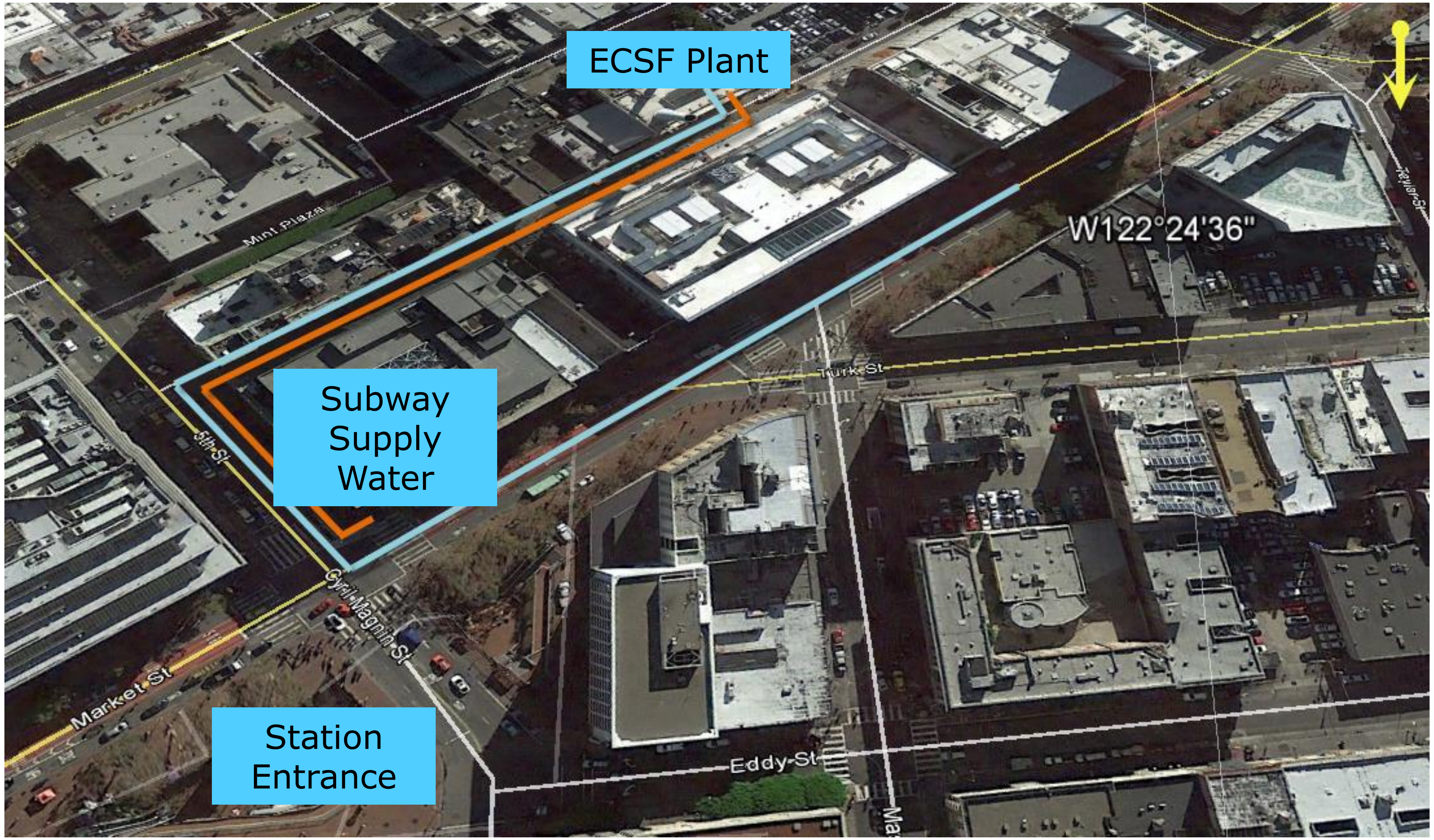
The Execution - Pipeline



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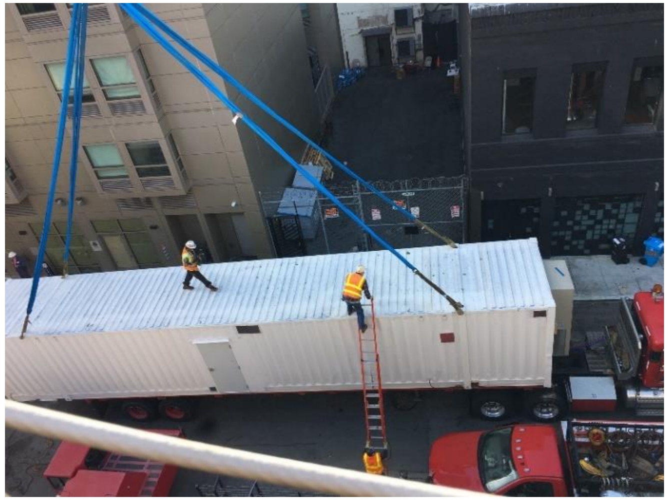
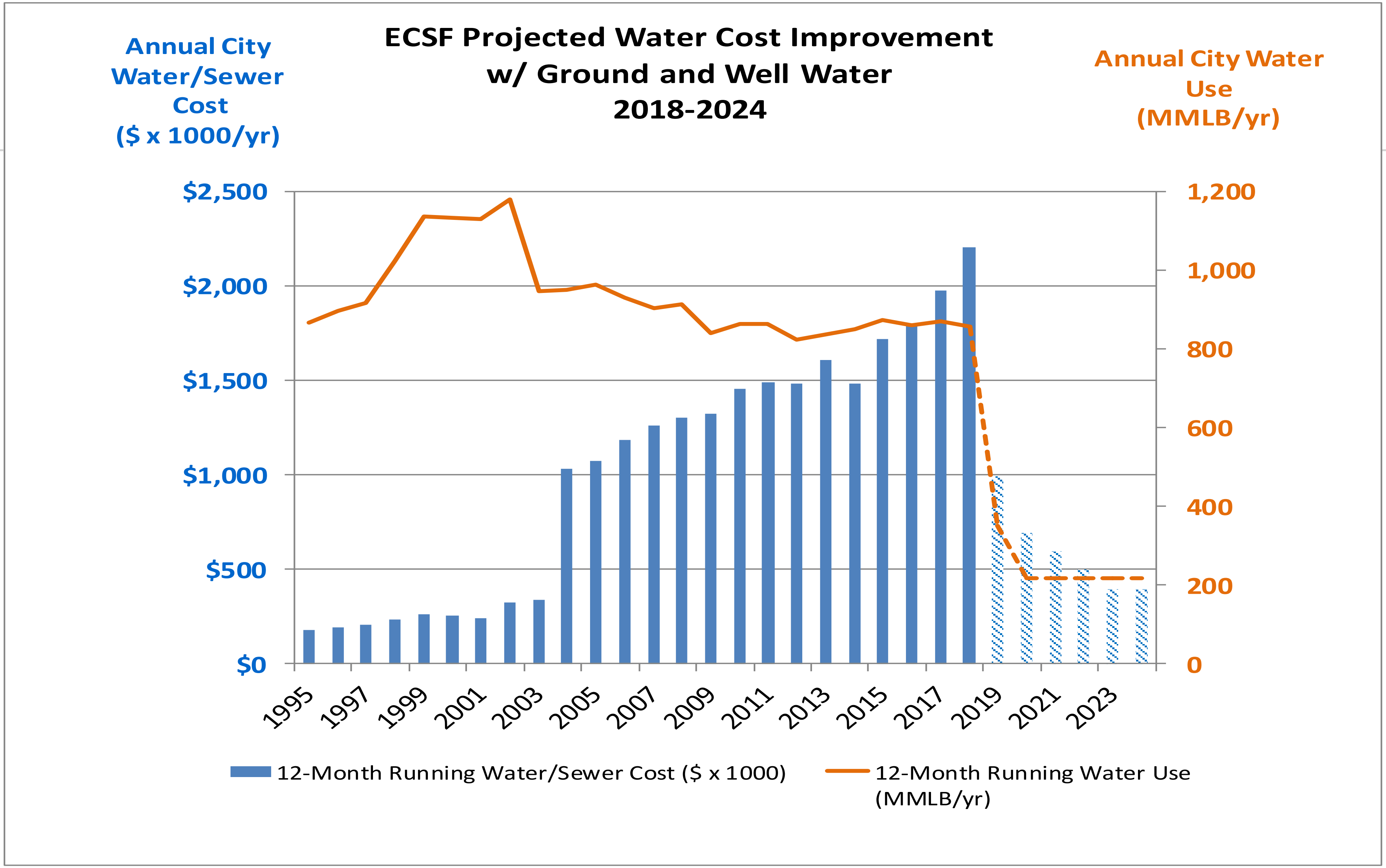
The Execution - Plant

- All Piping & Structural Steel Work Done by Employees
- Water Treatment Plant Was Mostly Modular Construction



The Results

- Total Project Cost (Ground Water Only): $3.5M
- Total Annual Savings (Ground Water Only): $1M, 3.0 year payback
  - $800k Water Sewer, $200k Chemical Savings
- SFPUC Grant for $500k
- Enhanced Savings by Adding On-Site Well
  - Test Well Indicates Steady 200 gpm Available for an Incremental $250k
  - Improves Project Savings by Additional $800k per Year, 0.3 Year Payback
- Using a Combination of Ground Water and Well Water Will Allow ECSF to Market a New Product Called "Sustainable Steam"
  - Goal Would be to get USGBC LEED Points to Enhance Marketing of Steam in San Francisco



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Lessons Learned

Lesson Learned #1

- Connecting to Existing Equipment
  - Electrical Failures
    - Higher Running Currents in Existing Lines
    - Higher Coincident Starting Currents
      - Caused Cogen Plant Trips
        - » High Current
        - » Islanding Due to Minimum Import
  - Carbon Steel Piping Downstream

Lesson Learned #2

- Not What We Expected in Subway Water
  - Did Not Show Up in Samples

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Lesson Learned #3

- Chemicals
- …..Lots of Chemicals

Chemicals Prior to RO Installation

Chemicals	Gal/Mo.	Size	pH	Comments
BL4350	90-150	1000	high	Boiler Scale Inhibitor
BL1555	120+	1000	High	Amine
BL122	50-100	405	High	Sodium Bi-Sulfite

Chemicals After RO Installation

Chemicals	Gal/Mo.	Size	pH	Comments
Bleach	30-120	TBD 405	Hi	Bleach tank
RL124	120	405	Low	Cl2 destruct
RL9909	90	405	Low	RO antiscalant
RL2016	90	405	Low	CIP cleaner
CL206	10	65	biocide	Biocide
RL1700	90	550	High	CIP Cleaning
BL1240	70	405	high	Sulfite
BL4350	90-150	1000	high	Boiler Scale Inhibitor
BL1555	120+	1000	High	Amine
BL1304	50-100	405	High	405 gal dual wall tank = 4’D, 59” H

Lesson Learned #4

- Chemistry is Different
  - Demin Water and Carbon Steel Piping
  - Demin Water in Direct Contact Economizer
    - Higher CO_2 Absorption with No Alkalinity to Buffer
    - Will Convert to Indirect Contact

Lesson Learned #5

- Better Than We Thought
  - Adding Well Tripled Water/Sewer Savings with only additional 10% Cost to Project
  - Desalitech Process Works Well
    - RO is Running 85-90% Permeate

Questions?