

Water and Liquid Nitrogen Conservation and Waste Reduction TEL FSI, INC.

Alex Mantos

MnTAP Advisor: Jane Paulson

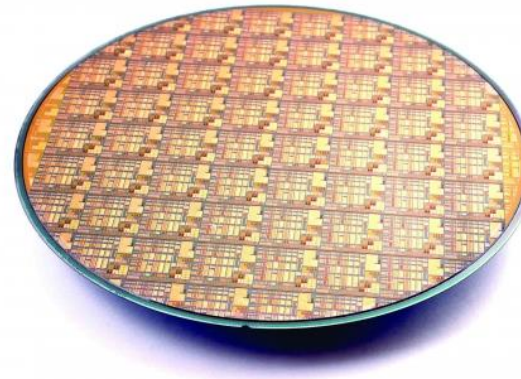


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TEL FSI Supervisor: Mark Jones

Company Background

- TEL FSI is a Subsidiary of Tokyo Electron US Holdings (TEH)
- Located in Chaska, MN
- Manufactures Semiconductor and Surface Preparation Equipment
- Two Clean Rooms: Production and Process Lab
- Products: ORION, ZETA, ANTARES



Motivation for Change

- Tokyo Electron Ltd. (TEL)
Corporate Environmental Goals
- TEL FSI Supports with Site-Wide
Water and Waste Goals
- Financial Savings



Project Overview

1. Reduce Deionized (DI) Water Usage in Process Lab:

- Find where water is sent to drain vs. reclaim
- Recommend monitoring systems

2. Determine Liquid Nitrogen Usage Benchmarks and Reductions:

- Determine benchmarks
- Check for nitrogen gas leaks
- Make recommendations for reductions

Project Overview (Cont.)

3. Optimize Recycling:

- Determine waste stream composition
- Reduce usage and recycle industry-specific items
- Increase recycling percentage



Methods

- **Water**

- Nomenclature system for valves
- Quantify water usage per tool

- **Liquid Nitrogen**

- Ultrasonic leak detection
- Flow meter and pressure tests
- Data logs from tools

- **Waste**

- Conduct trash sort
- Recommend and implement specialty recycling streams



Water Reduction

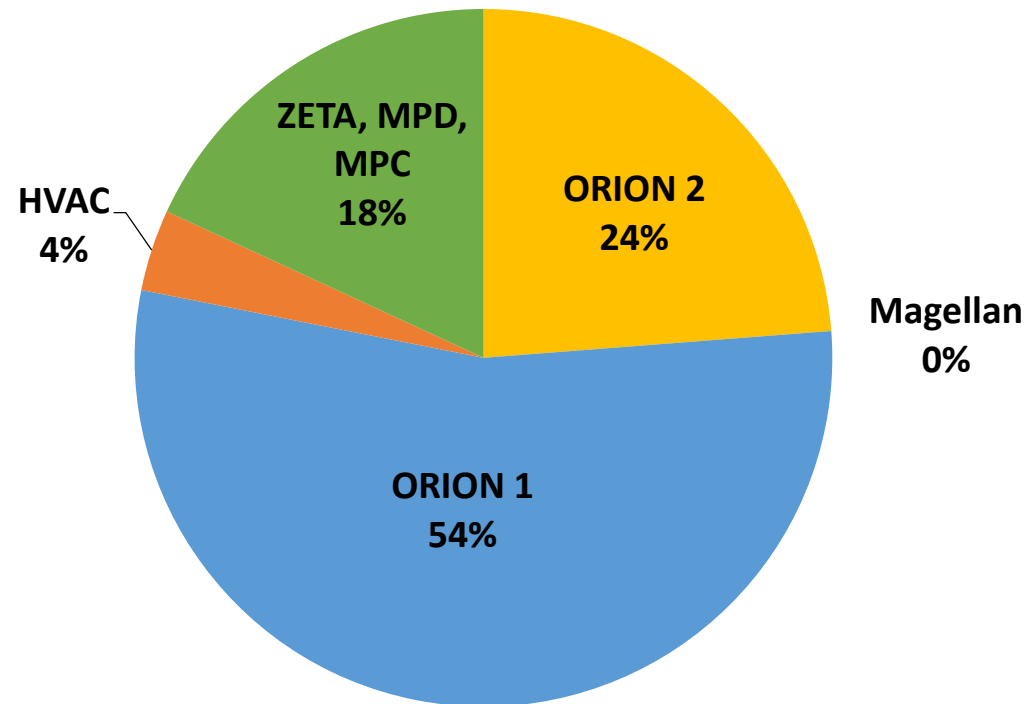
Benchmarks – Water

- Goal of Using Less Water than in Calendar Year 2015
- Process Lab Uses 75% of Total Water
- Water Sent to Bypass for Reclaim or drain for Sewage
- Tank Level Measurements



Water Findings – Tank Level

Idle Drain Volume of Process Lab DI Water



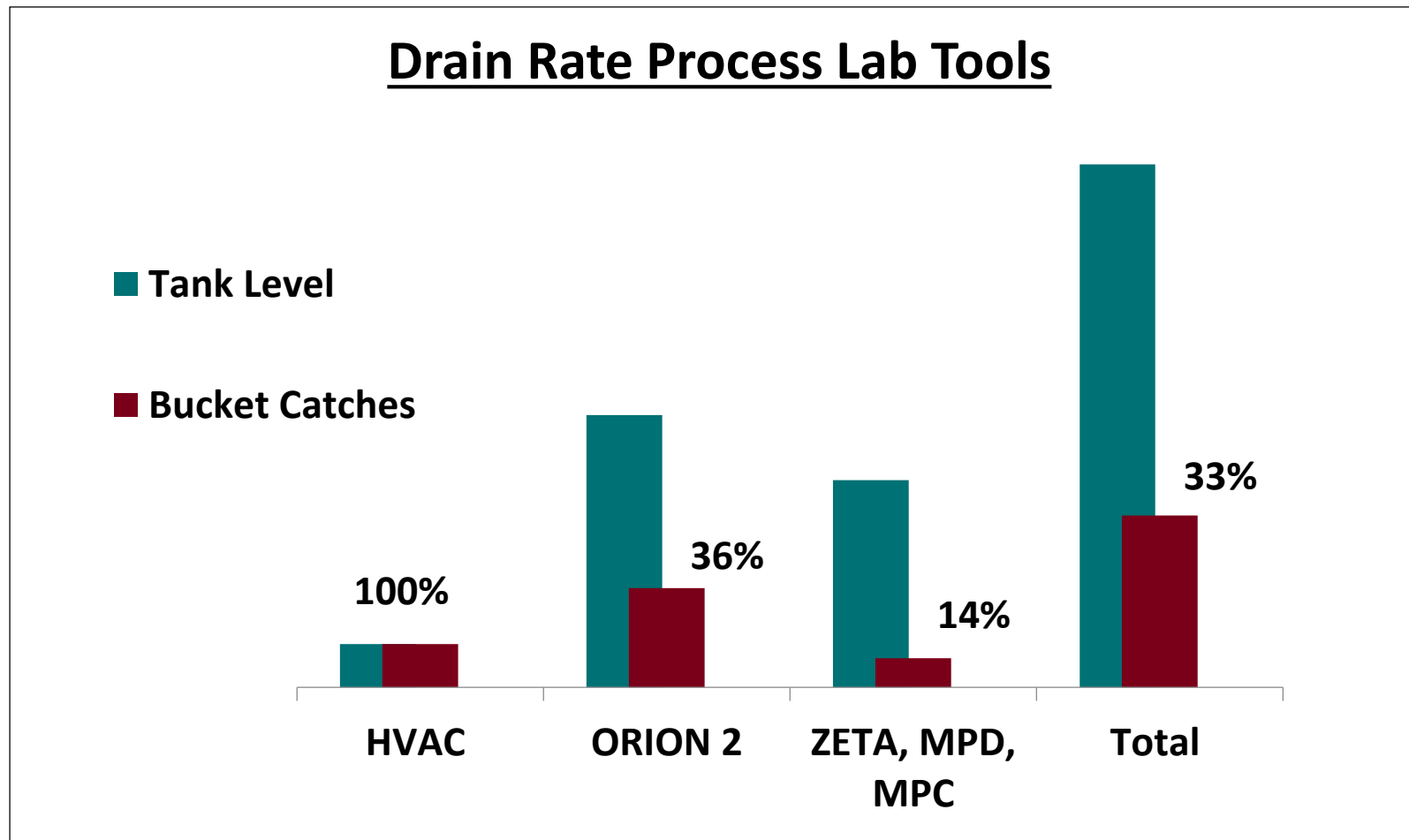
Water Recommendation – ORION 1

1. Decommission ORION 1

- Tool is not in use
- Will save 40% of facility water
- Additional savings in electricity and chemical usage

Recommendation	Water Reduction (per year)	Implementation cost	Estimated net savings (per year)	Payback period	Status
1. Decommission ORION 1	40%	None	\$75,000	Immediate	Implemented July 27 th , 2016

Water Findings – Bucket Catches



Water Recommendation- Monitoring

2. Install Water Meters

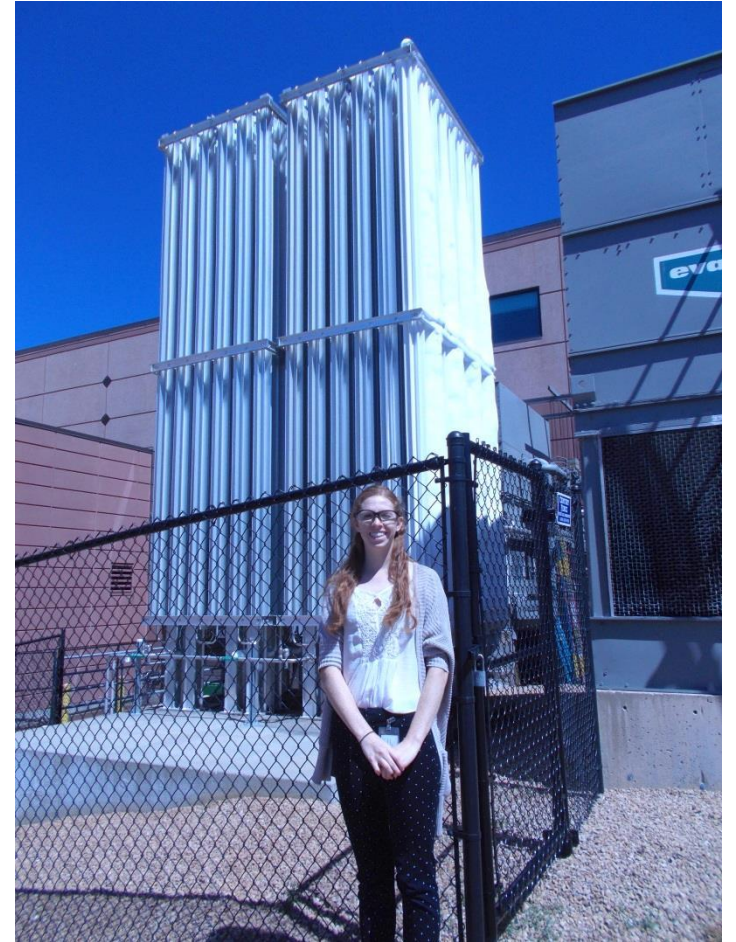
- Assist in future water reductions
- Process Lab is dynamic

Recommendation	Water Reduction (per year)	Implementation cost	Net savings (per year)	Payback period	Status
2. Install Water Meters	Potential 23%	\$15,000	\$42,000	4 months	In Review

Liquid Nitrogen and Nitrogen Gas Reductions

Benchmarks - Liquid Nitrogen

- Delivered as Liquid Nitrogen (LN₂)
- Portion is Intentionally Converted to Nitrogen Gas (N₂)
- Goal of Using Less Nitrogen than in 2015
- Uses:
 - Product testing
 - Idle state for tools
 - Nitrogen blanket for reverse osmosis



Nitrogen Recommendation – ORION 1

ORION 1 Uses N₂ in Wafer Testing and Idle State

Recommendation	Nitrogen Reduction (per year)	Implementation cost	Net savings (per year)	Payback period	Status
1. Decommission ORION 1	3%	None	\$15,000	Immediate	Implemented July 27 th , 2016

Nitrogen Findings – Ultrasonic Leak Detection

- Ultrasonic Leak Detection
- Traced Nitrogen, Argon, and Compressed Dry Air (CDA) Lines
- Leak Monitoring System Implemented in 2014



Nitrogen Recommendation – Gas Leaks

Ultrasonic Leak Detection

- Identified N₂, Argon, and CDA
- Most were small leaks
- Approximately 0.4 SCFM

Recommendation	Nitrogen Reduction (per year)	Implementation cost	Net savings (per year)	Payback period	Status
2. Fix Leaks	1.5%	None	\$6,600	Immediate	Partially Implemented

Recycling Optimization

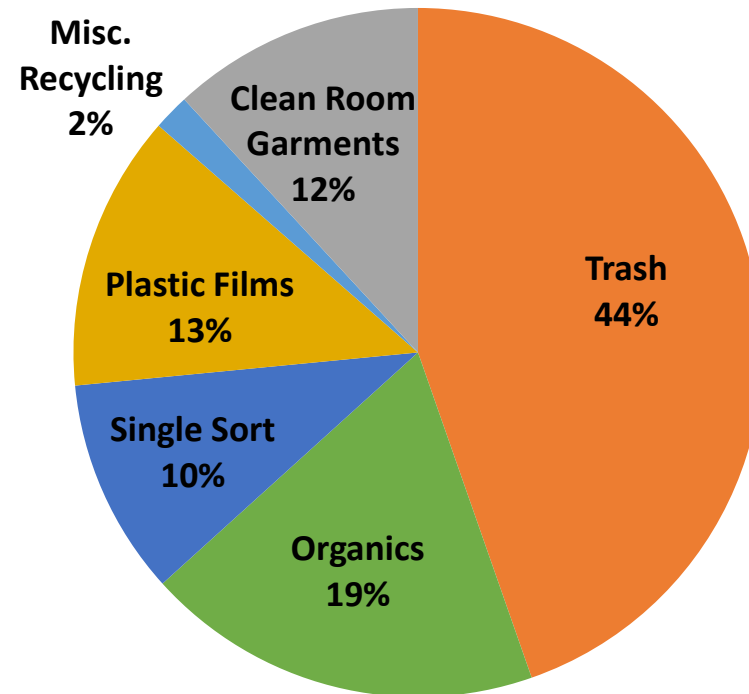
Benchmarks – Waste

- TEL FSI Projected Recycle Rate of 75% for Calendar Year 2016
- TEL Corporate Goal of 97%
- Reuses and Recycles Shipping and Packaging items
- Recycles Industry-specific Items



Waste Findings

Trash Composition



Waste Recommendation – Expand Recycling Streams

- Add Compost Stream
- Expand Plastic Films Recycling
 - Add to Process Lab
 - Education materials
- Utilize VWR Clean Room Garment Recycling Program
 - Accepts bouffants, shoe covers, beard covers
 - Turns into plastic resin



RECYCLING

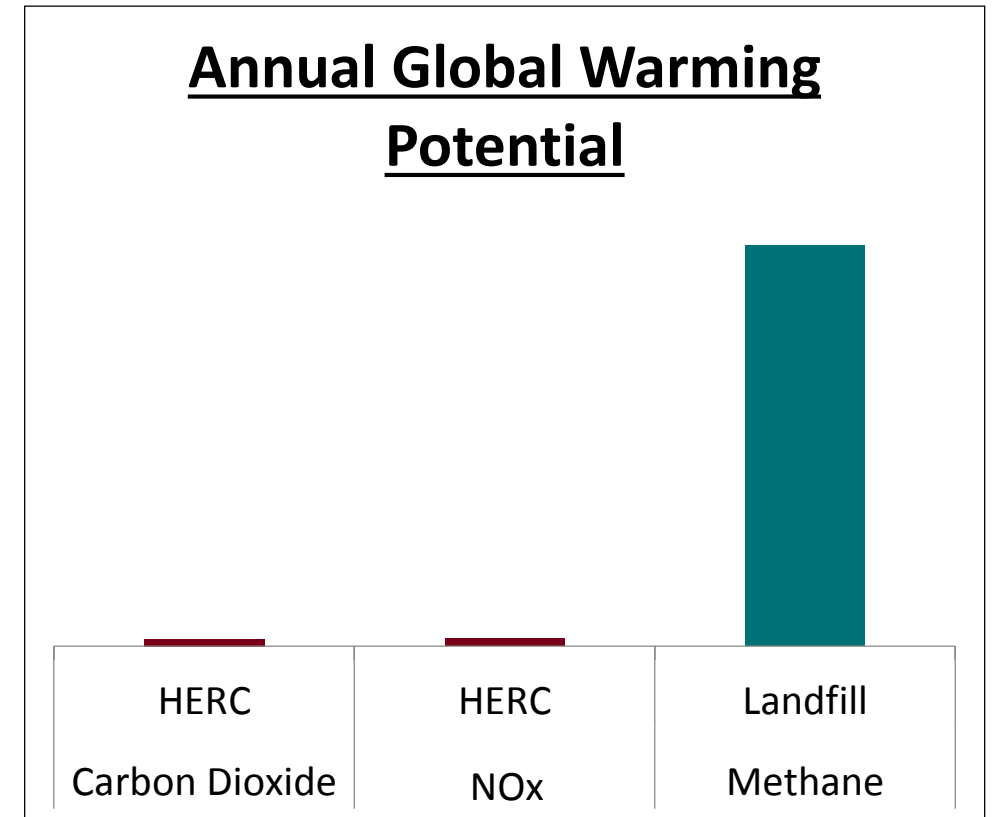


Plastic Bags
Plastic Bubble Wrap
Plastic Wrap

TEL™

Waste Recommendation – Send Trash to Waste To Energy Facility

- **Hennepin County Energy Recovery Center (HERC)**
 - Incinerates trash to produce electricity and steam
 - Reduces landfill waste by 75%
 - Reduces global warming potential by 96%
- **Would Require Switching Waste Hauler**



Waste Recommendations

Recommendation	Waste Diverted or Repurposed (Tons/Year)	Proposed Recycling Rate	Net savings (per year)	Status
Implement Compost and Switch Recycling Hauler	4	79.4%	\$240	Planned
Expand Plastic Films Recycling	3.2	78.2%	None	Partially Implemented
Recycle Clean Room Supplies through VWR	2.3	77.2%	-\$1200	Planned
Switch Hauler to utilize Waste to Energy Facility (HERC)	12	92.8%	\$5,100	Planned
Switch Paper Shredding Hauler	None	No Change	\$620	Implemented
Total	19.2	95.7%	\$4,800	

Summary of Recommendations

Recommendation	Reduction (per year)	Implementation Cost	Net savings (per year)	Status
Water Recommendations	63%	\$15,000	\$117,000	Implemented or In Review
Nitrogen Recommendations	4.3%	None	\$21,600	Partially or Fully Implemented
Waste Recommendations	19.2 tons	None	\$4,800	In Review or Being Implemented
Total	--	\$15,000	\$168,000	

Personal Benefits

- Experience Working Within and Leading Teams
- Confidence in Working in a New Field
- Expanded Future Career Horizons



Questions?

Project was supported in part by the Minnesota Pollution Control Agency (MPCA) and the Metropolitan Council Environmental Services (MCES)