EAST BAY MUNICIPAL UTILITY DISTRICT

Key Factors to Enable the Anaerobic Digestion of Food Waste at WWTPs

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East Bay Municipal Utility District
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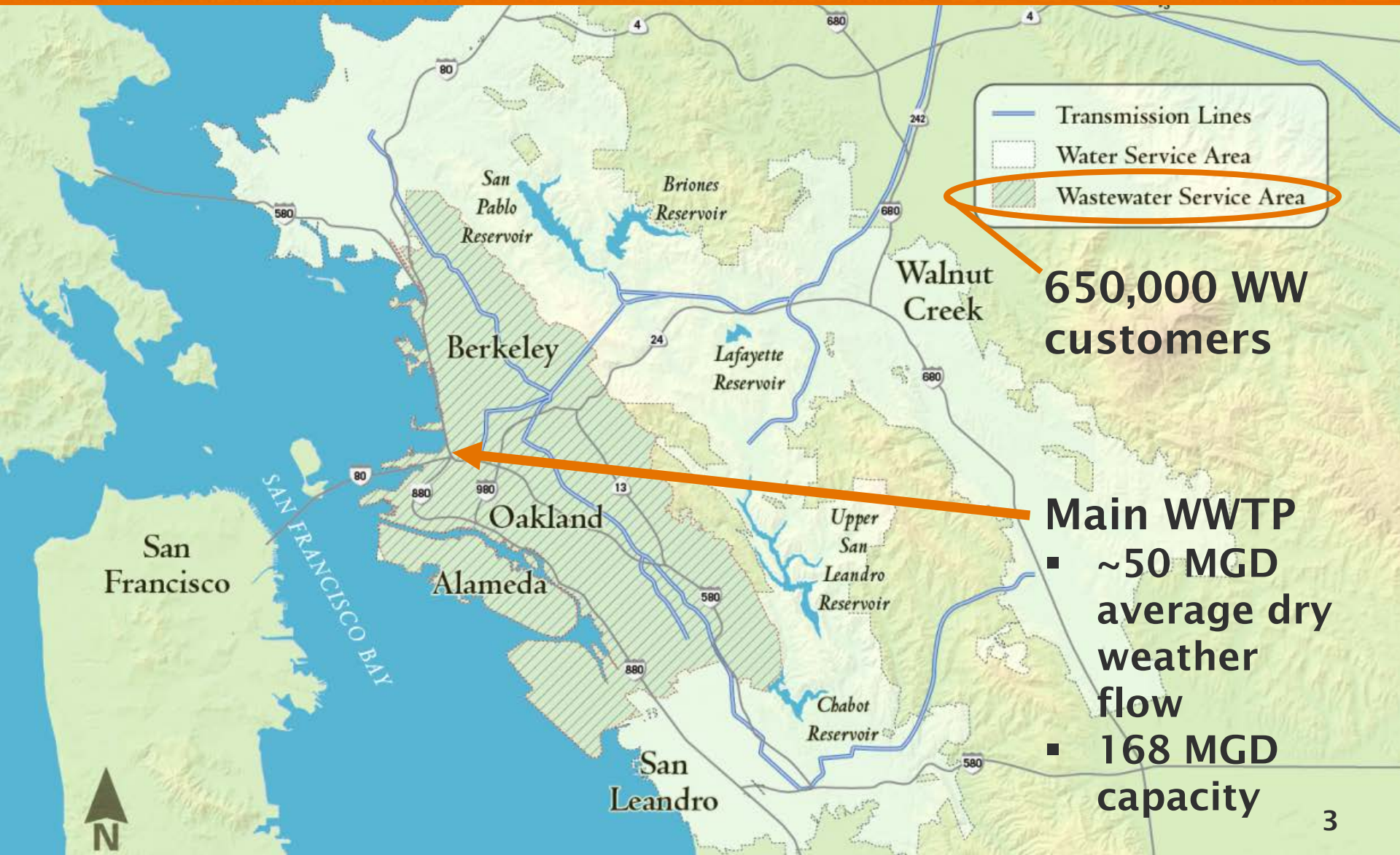
Presentation Overview

- EBMUD Background
- Resource Recovery (R2) Program Overview
- Biogas Production and Utilization
- R2 Program Evolution
- Existing Food Waste Program
- FW Program Expansion and Keys to Success
- Next Steps and Lessons Learned

EBMUD Background
Service Area



EBMUD Background
Excess Digestion Capacity

- 11 in-service anaerobic digesters (1.8 MG each)
- Canneries facility was designed to serve: **20**
- Remaining canneries: **0**

R2 Program Overview
Trucked Waste

- Began accepting trucked waste in 2002
- 4,000 trucks/month
- 20 million gallons/month non-hazardous liquids
- Trucked wastes received 24-7, 365 days/year

2002 **Septage Receiving $1M**

2004 **Solid-Liquid Receiving $7M**

2014 **Blend Tank Receiving $13M**

R2 Program Overview
Renewable Energy Generation

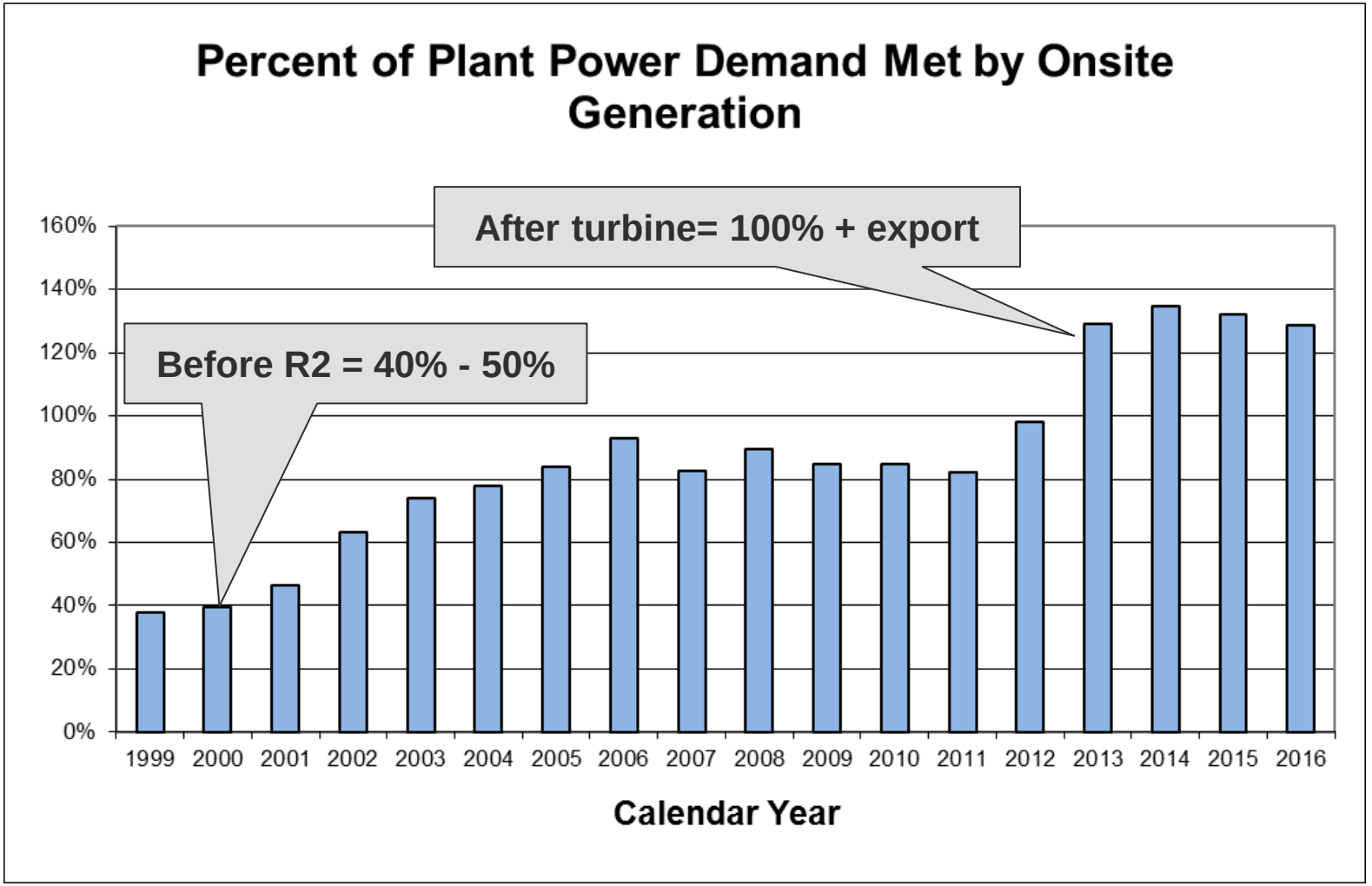
- Savings of ~$2M on plant power costs
- Electricity export revenue of ~$1M/year
- First wastewater treatment plant in N. America to produce more electricity than plant demand

1985 Three 2.2 MW engines

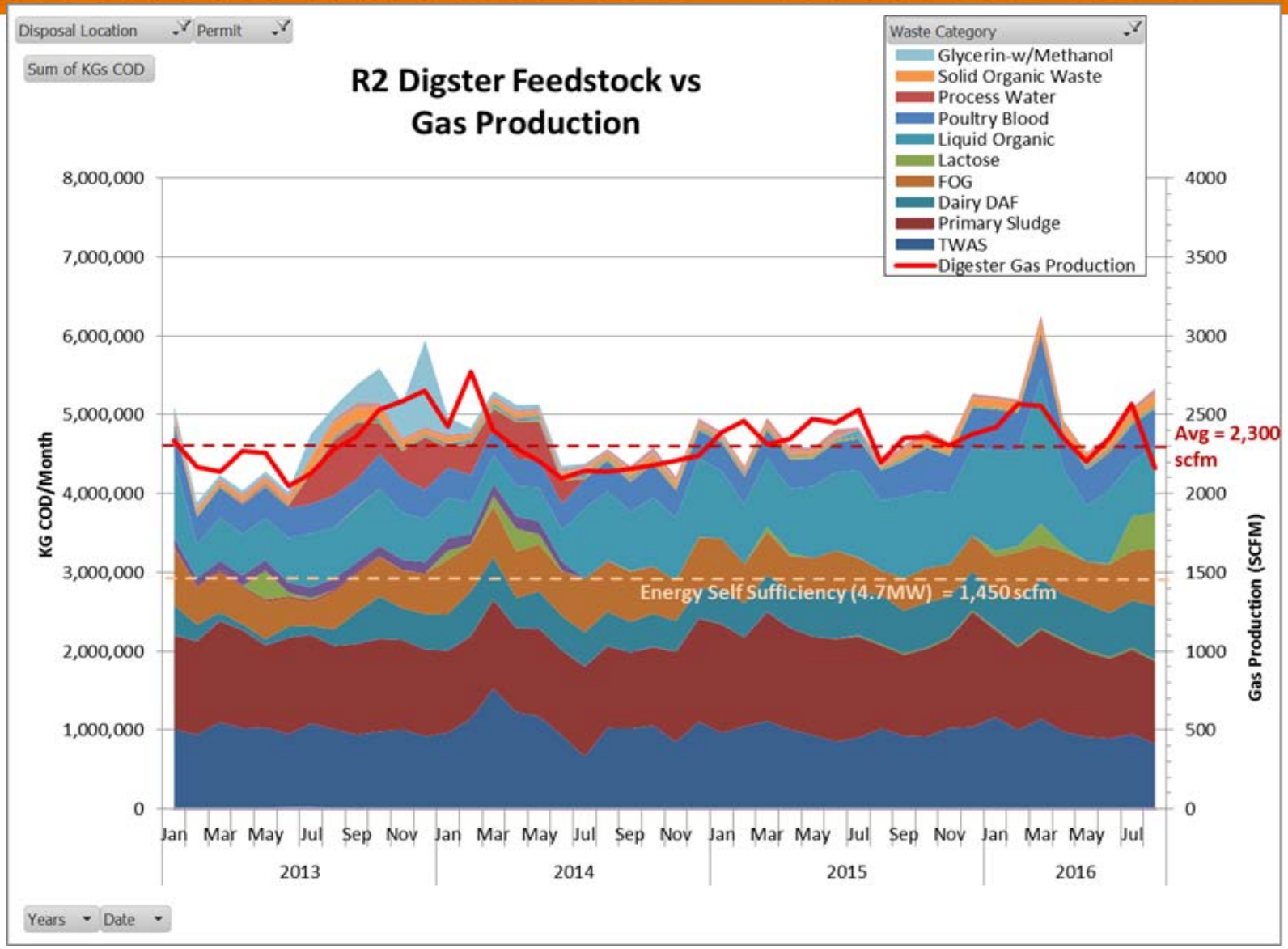
2013 4.5 MW Turbine $13M

R2 Program Overview
Renewable Energy Generation

% of WWTP demand met by onsite generation



Biogas Production
High Strength Waste Contribution

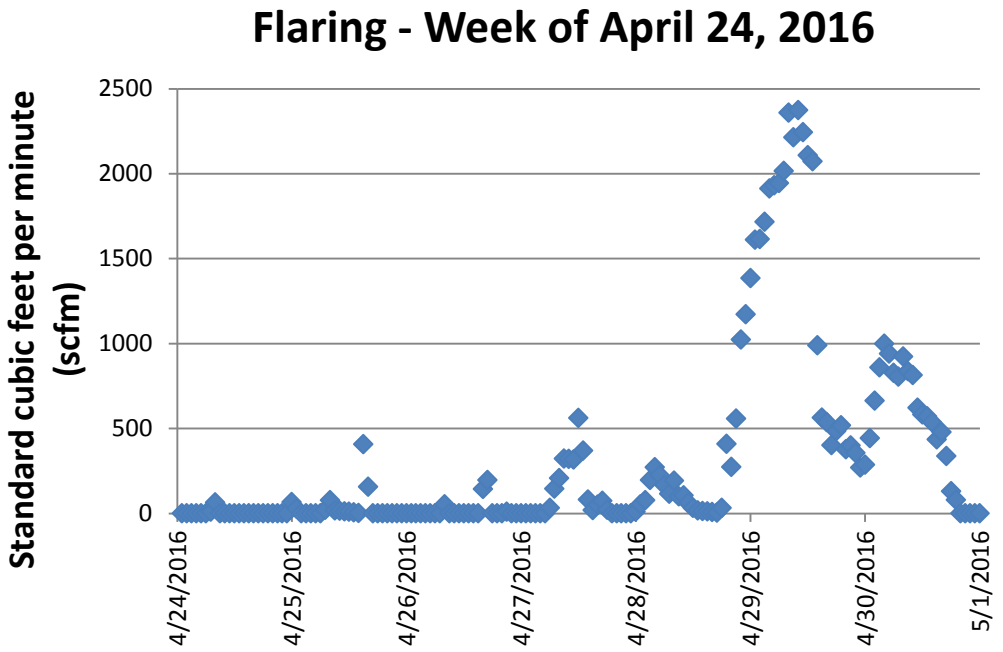


~2/3 of biogas from R2 wastes

Biogas Utilization
Current Flaring Patterns

Biogas Utilization	2015 Volume (cubic ft)	% of Total
Turbine	533,000,000	47%
Engines	471,000,000	41%
Boiler	5,000,000	0.4%
Flare	137,000,000	12%
Total	**1,145,000,000**	

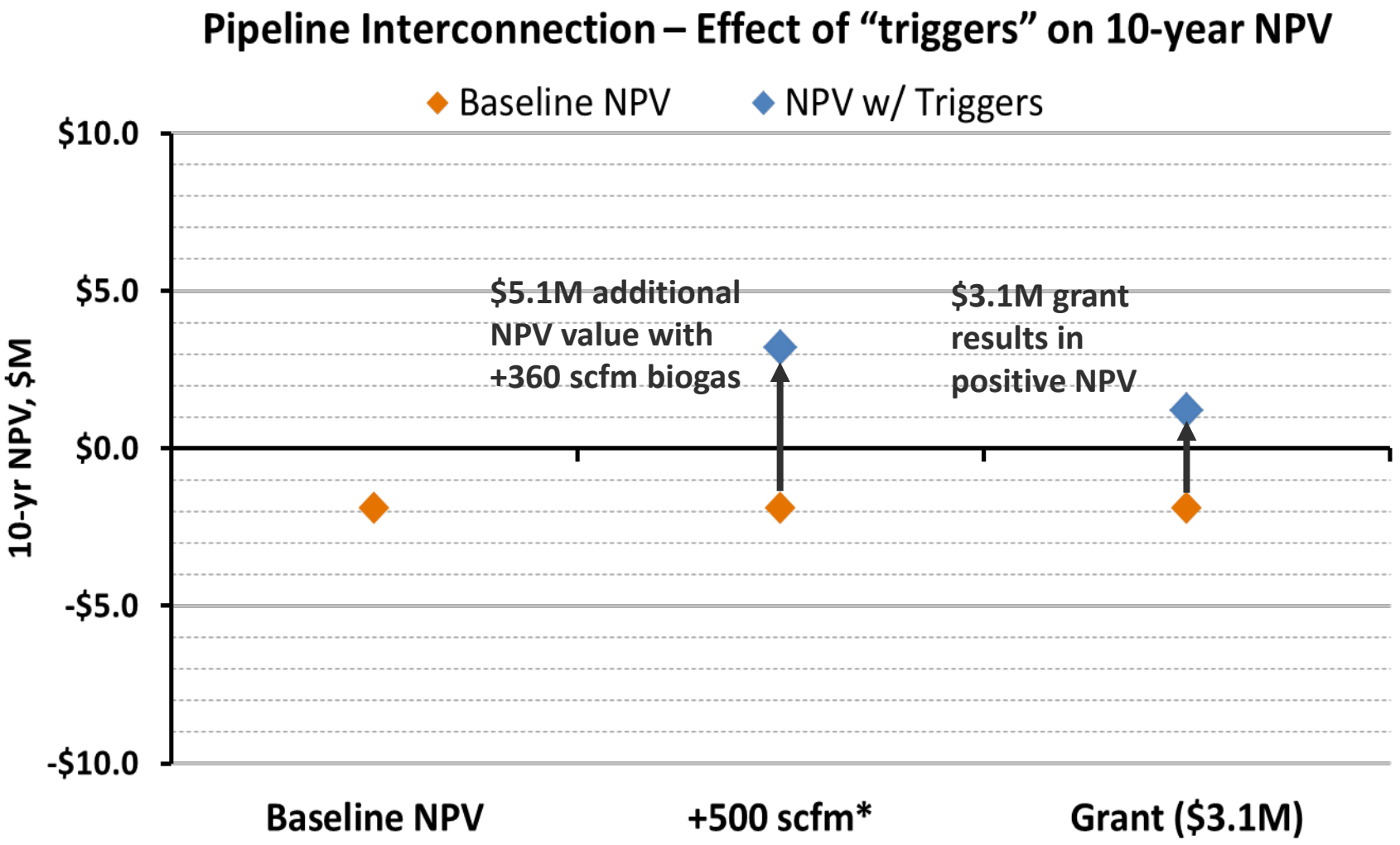
High strength wastes are delivered on no particular schedule. EBMUD often flares at the end of the week as deliveries increase and biogas production exceeds generation capacity.



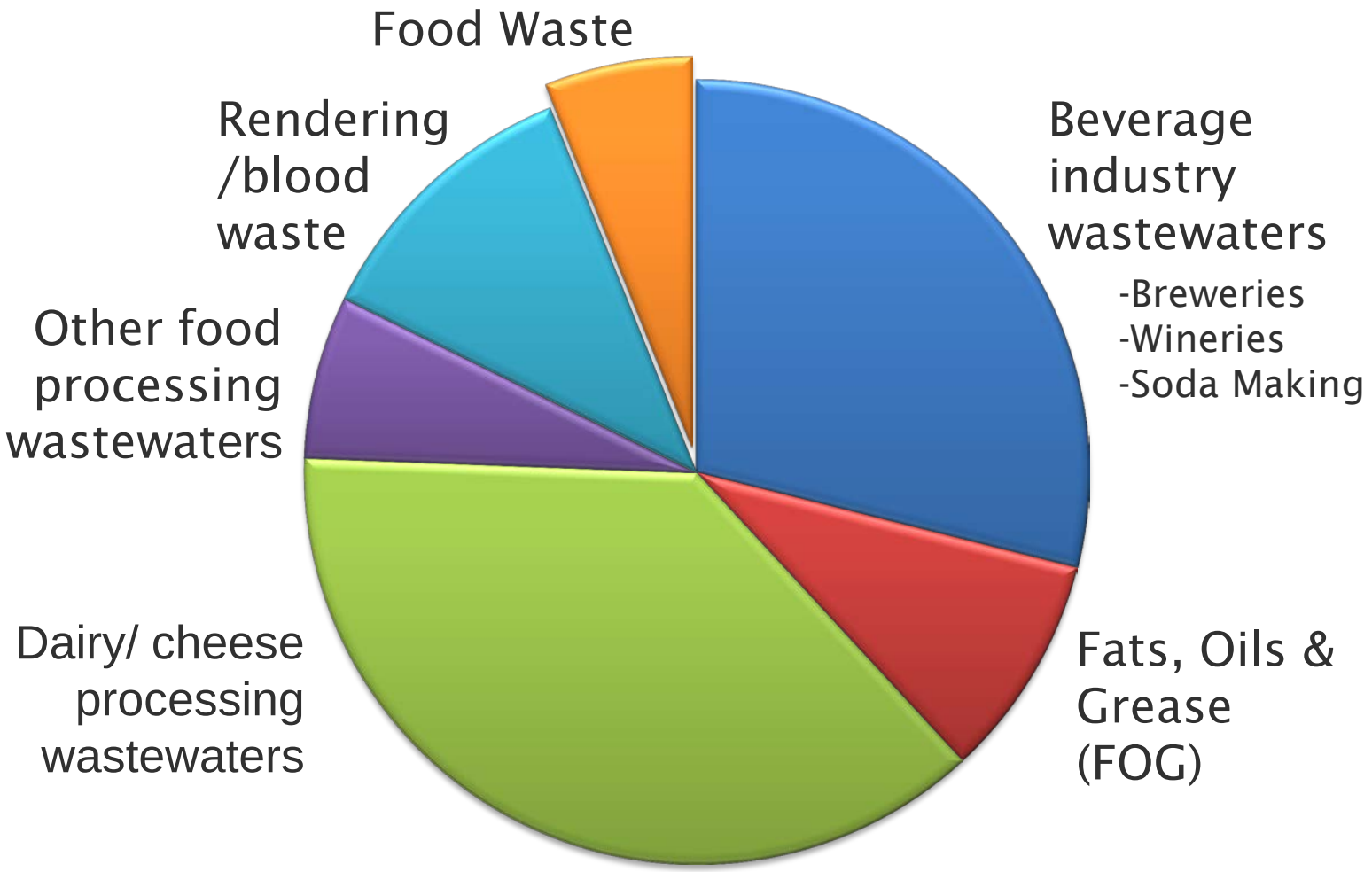
Biogas Utilization
Biogas Alternative Analysis

Biogas Alternative	Comments
Biogas Storage	Biogas storage would reduce flaring by 7 to 13% but best to implement with future digester rehabilitation.
Additional Turbine	Greater benefits with >500 scfm additional biogas beyond current production.
CNG Production	CNG potentially a viable option, especially if an additional ~500 scfm biogas is produced such that existing electricity sales continue. Public filling station/tube trailers or pipeline injection considered.
Renewable Liquid Fuel Production	Bleeding edge technology and uncertain regulatory environment. No known successful analogous projects.
Hydrogen Production	Potential option as a biogas off-take agreement with a private partner.

Biogas Utilization
NPV of 500 scfm biogas project



R2 Program Evolution
An Evolving Feedstock Portfolio



FY 2016 High-Strength Wastes

R2 Program Evolution
Food Waste Program Expansion

R2 Program Evolution
Benefits of FW Digestion at WWTPs

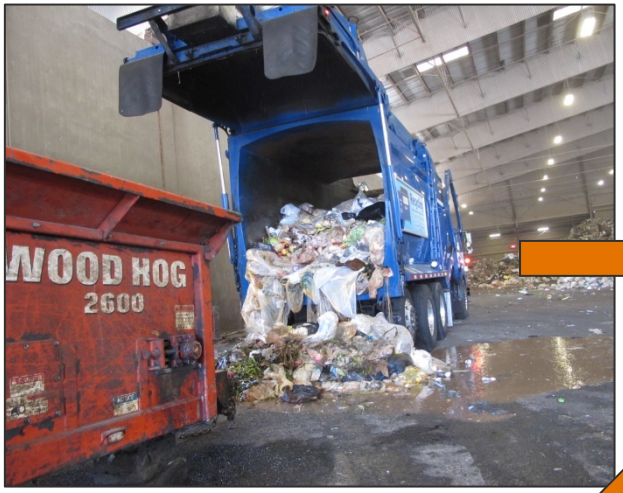
- Landfill diversion plus generation of renewable energy prior to compost or land application
- Volume reduction, less trucks on the road
- Most communities generate food waste and have wastewater treatment facilities – shorter haul distances
- Leverage existing infrastructure

R2 Program Evolution
Key Challenges in Scaling Up FW

- Competing for feedstock
  - Lowest cost is landfill disposal
  - Next lowest is poor quality compost
  - Followed by high quality compost
  - Highest net cost is anaerobic digestion (including the offset of the energy revenues)
- Costs for anaerobic digestion likely to become more competitive as technology matures and the value of the renewable energy is fully captured
- Capital investments
  - Managing risks
  - Not core business for wastewater agencies
  - Partnering is key

Existing Food Waste Program
Preprocessing SSO Offsite

1. Source separated organics (SSO) on transfer station tip floor



2. Food waste after grinding

3. Off-loading at EBMUD

4. Contaminant removal at EBMUD

Existing Food Waste Program
Ongoing Pilot Study: OFMSW

1. Press at offsite facility

2. Reject from offsite press

3. Off-loading at EBMUD

4. Contaminant removal at EBMUD

Food Waste Program Expansion
Pre-processing Offsite or Onsite?

- Onsite advantages:
  - Potential for direct haul to WWTP
  - Greater control of quality of material sent to digesters
  - “Build it and they will come”
- Offsite advantages:
  - Potential cost savings due to existing physical and administrative infrastructure at offsite locations
  - Synergy with other transfer station operations

Food Waste Program Expansion
Significant Capital Cost

EBMUD

Pre-processing Equipment

Food Waste Program Expansion
High Costs, Uncertain Revenues

Tip Fees ($/ton)		Biogas Revenue ($/ton)		Operating Costs ($/ton)		Net Operating Revenue ($/ton)	
worst	best	worst	best	worst	best	worst	best
$50	$100	$5	$40	-$100	-$25	-$45	$115

100 TPD project 20 year present value ($M)	**-$20**	**$50**
100 TPD project capital cost ($M)	**$40**	**$20**
20 year project NPV ($M)	**-$60**	**$30**

Notes:

- $/ton is $/ton as-collected source-separated organics
- 4% discount factor used, escalation not included

Keys to FW Program Success
External Factors

✓	Proximity to local sources of food waste	➢ Densely populated San Francisco Bay Area ➢ EBMUD proximity to Port may afford opportunities for additional food waste
✓	Favorable regulatory environment	➢ California regulatory agencies willing to be flexible in order to achieve broad climate change/sustainability goals
✓	Limited food waste disposal alternatives	➢ Increasingly difficult for composters to operate in urban environments ➢ California regulations increasingly restrict landfilling of organics
✗	Markets for end products	➢ Prices for renewable energy and alternative fuels at historic lows ➢ Under-developed market for digestate fertilizer products

Keys to FW Program Success
Internal Factors

✓	Institutional framework and internal support	➢ R2 program performance supports continuation/expansion ➢ Existing administrative framework for trucked waste program
✓	Existing infrastructure/ excess capacity	➢ >200 tons per day (TPD) capacity at digesters ➢ ~60 TPD capacity at dewatering ➢ Limited excess capacity for power generation
✗	Ability to offset existing O&M costs	➢ WWTP electrical demand already met ➢ Limited opportunities to fuel EBMUD fleet with compressed natural gas (CNG)
✗	Control of feedstock quantity and quality	➢ EBMUD is not a municipality and has no control of waste hauling contracts ➢ Contamination level of food waste greatly influences operating costs

EBMUD Next Steps and Lessons Learned

- Continue on current course with:
  - Pilot studies
  - Development of partnerships
  - Investigation of FW program expansion
- Keeping in mind:
  - Resource Recovery requires innovative thinking and problem-solving approach
  - Adaptive management is key to addressing multiple, unanticipated challenges
  - Resource Recovery is not without risk and competition is real

Questions?

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