Food Waste Co-Digestion in California: The Role of WRRFs and Investment Needs to Maximize Co-Digestion in Support of SB 1383

September 9, 2020

Greg Kester

MODERATOR

Director of Renewable Resource Programs

CASA

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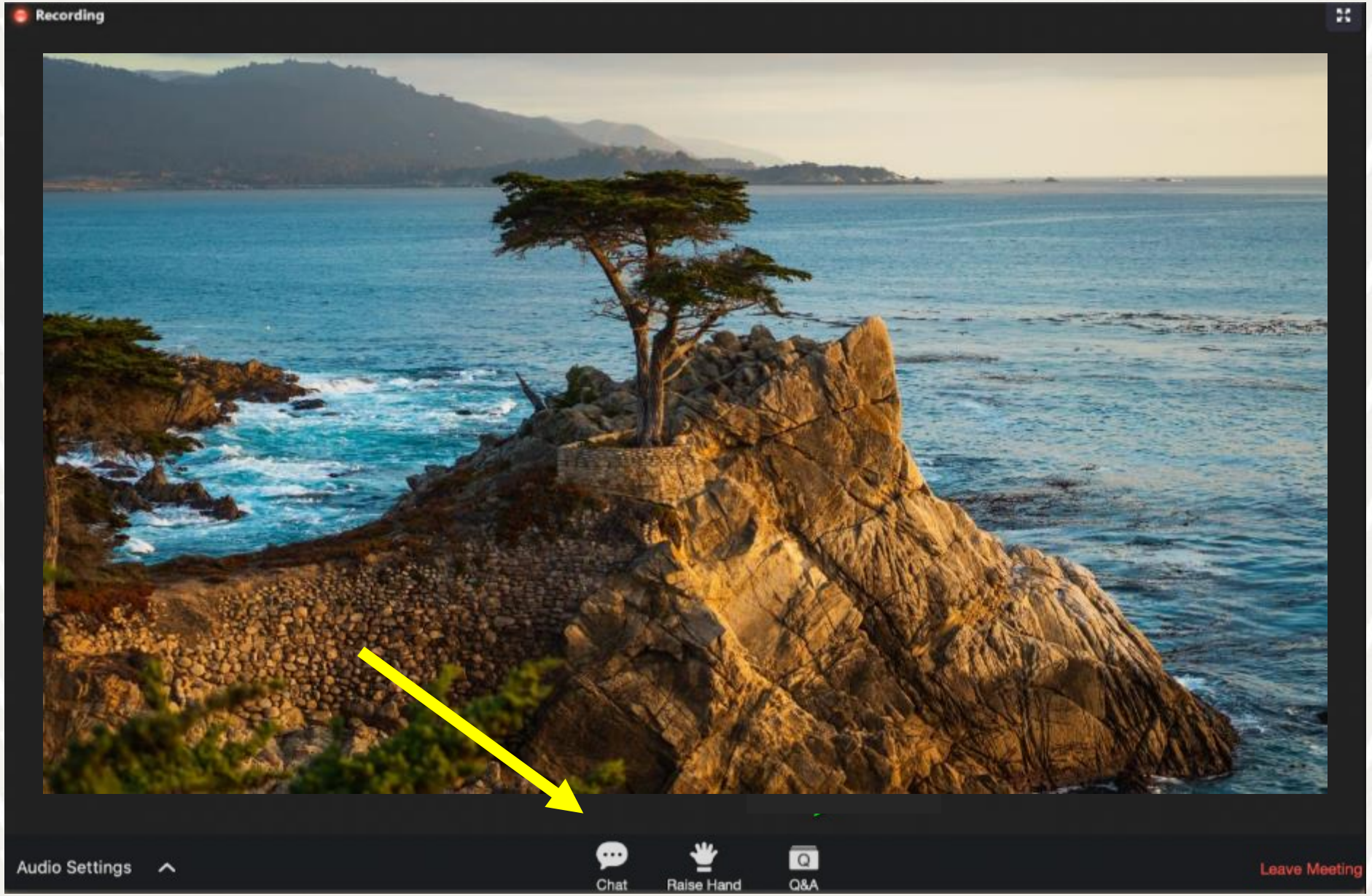
For reporters: all speakers today are off the record.



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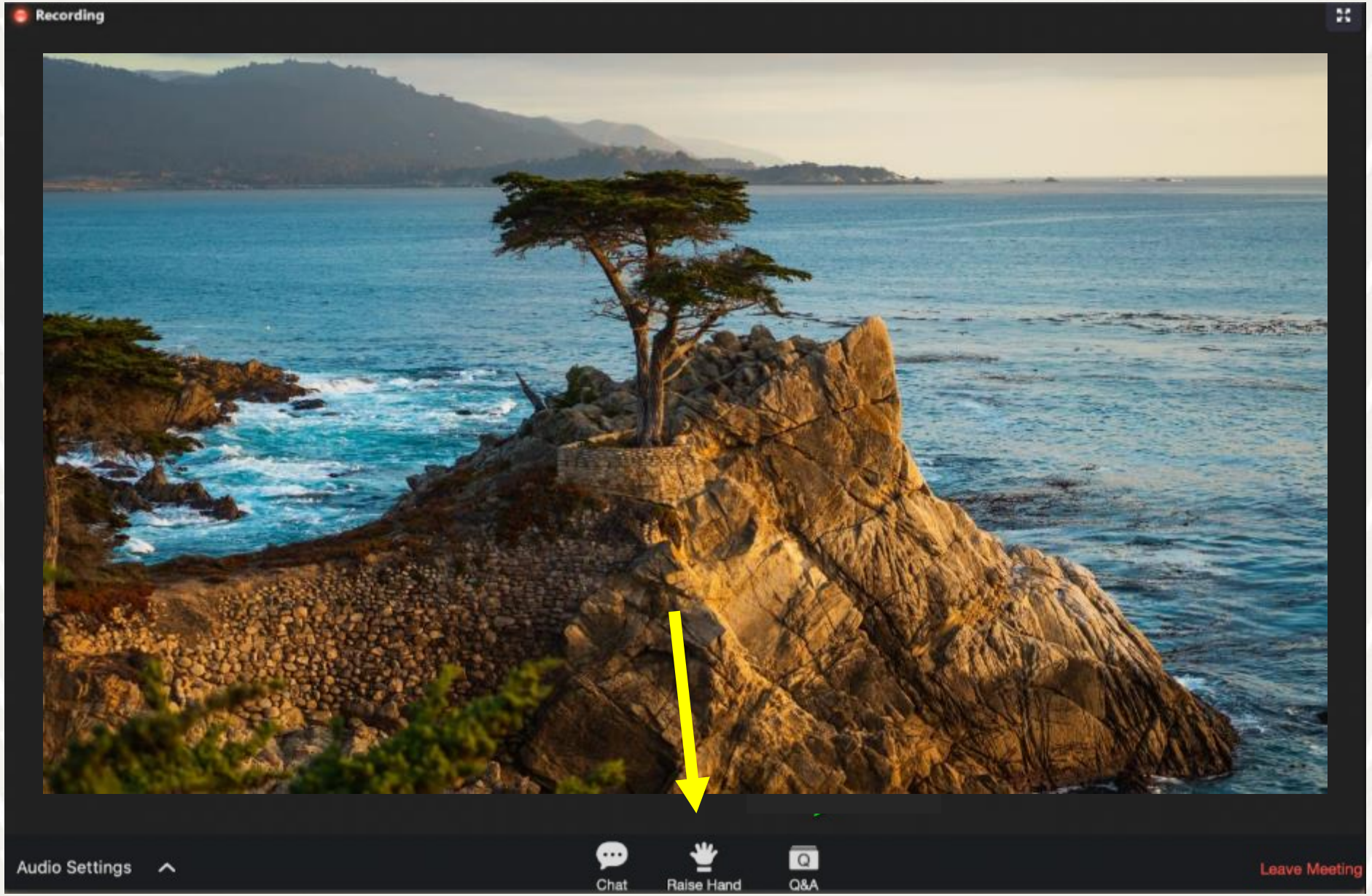

Zoom Controls: Raise Hand Feature Not Used in Today's Webinar

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Food Waste Co-Digestion in California: The Role of WWRFs and Investment Needs to Maximize Co-Digestion in Support of SB 1383

Rashi Gupta, P.E.
Elizabeth Charbonnet, P.E.
Sarah Deslauriers, P.E.

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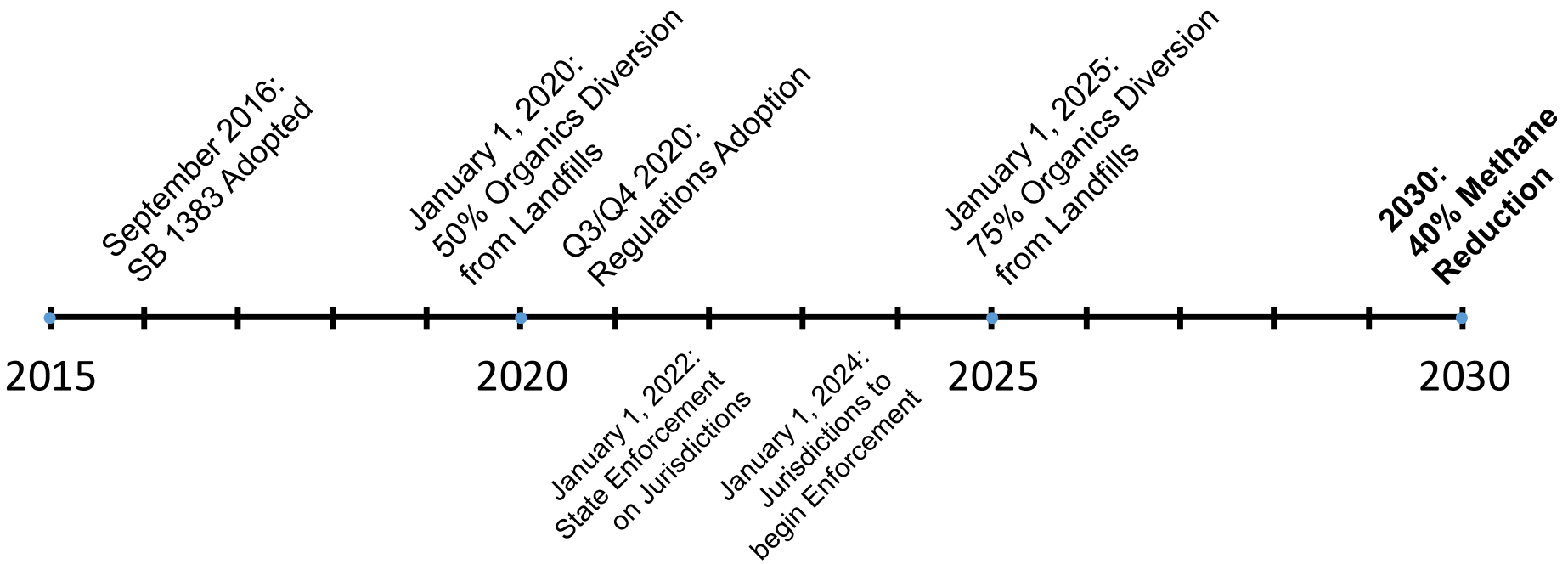
// Thank you to the project team, participating California facilities, SWRCB, and CASA

- Project Team
  - Elizabeth Charbonnet
  - Sarah Deslauriers
  - Rashi Gupta
  - Chelsea Ransom
  - Rob Williams
- State Water Resources Control Board
  - Charlotte Ely
  - Max Gomberg
  - Jelena Hartman
- Facilities who participated in survey and case studies
- Technical reviewers and advisors

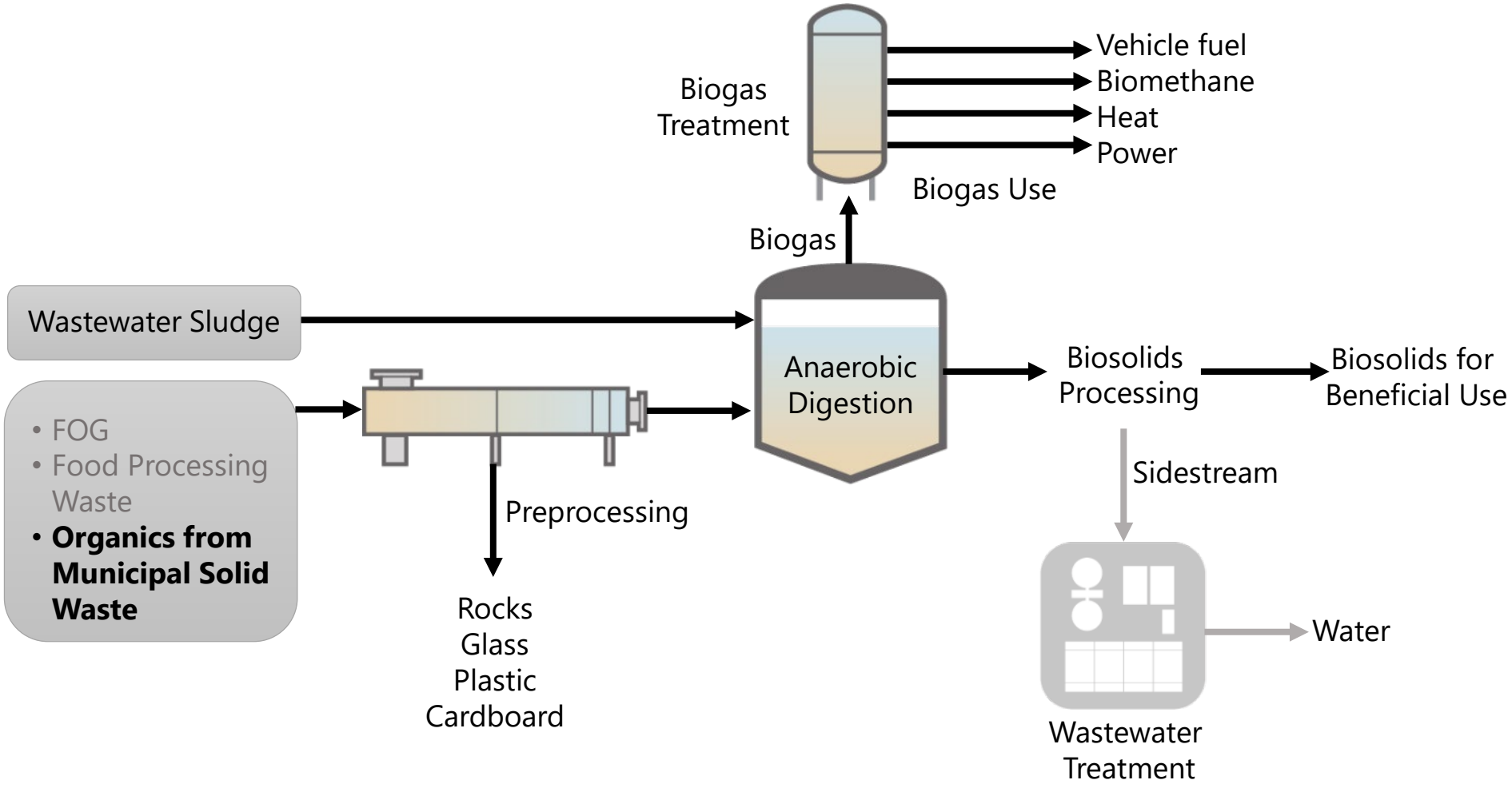
// California's Senate Bill 1383 (SLCP Reduction Implementation): Organic Waste Reduction Timeline



SLCP: Short-lived Climate Pollutants, including methane.
Methane reduction relative to 2013 levels.
Diversion relative to 2014 levels.

// California seeks to reduce methane emissions – co-digestion at WRRFs could play a major role

// What is co-digestion?



// Lots of talk in the last few years about excess digester capacity and producing renewable energy at WRRFs

Can California use this capacity to help meet its methane-reduction goals?

// State agencies had many of the same questions about co-digestion as you probably do

What could impact feasibility?

How much capacity do we really have?

How much additional capacity do we need?

How much food waste can we accommodate?

Could WRRFs generate revenue from it?

How much will it cost to implement?

If it's so great, why isn't everyone already doing it?

How much of an impact will it make?

CALIFORNIA Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

Co-Digestion Capacity Analysis
Prepared for the California State Water Resources Control Board under Agreement #17-014-240

CO-DIGESTION CAPACITY IN CALIFORNIA

FINAL | June 2019

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Co-Digestion Capacity in California

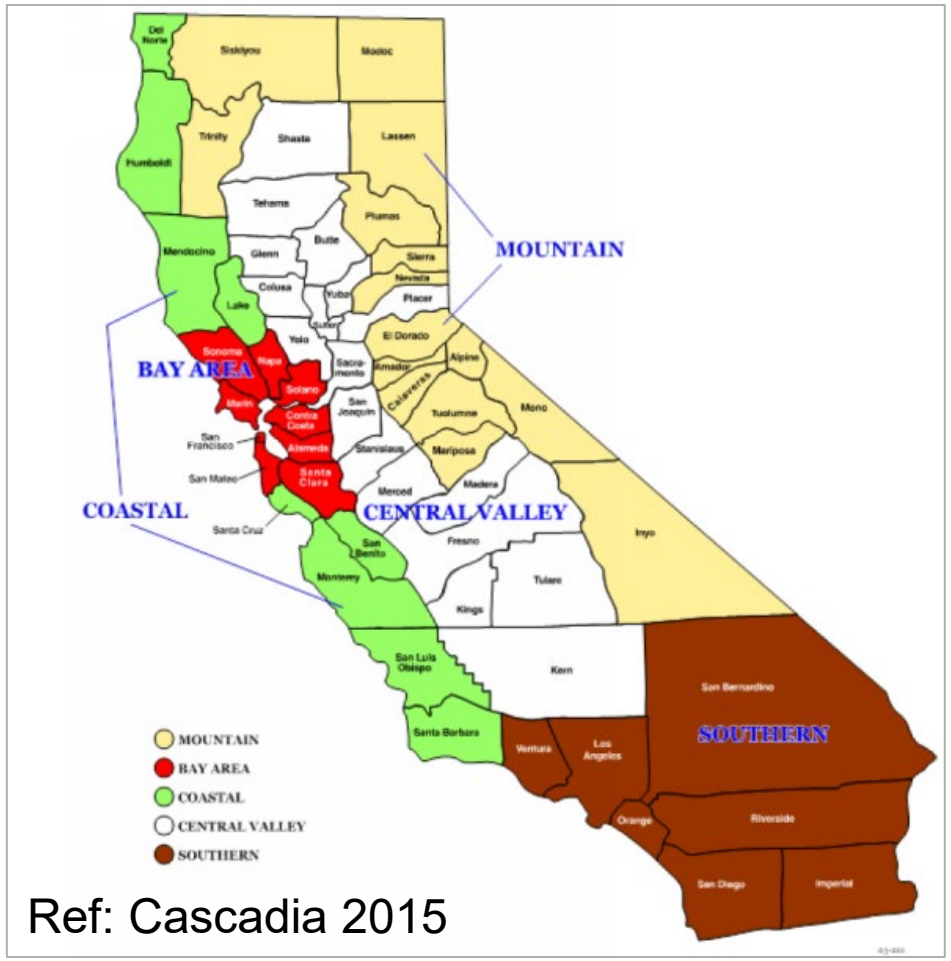
Six-Chapter Report with Appendices

- *Finalized June 2019*
- *Multi-agency review at State level*
- *Published August 2020*

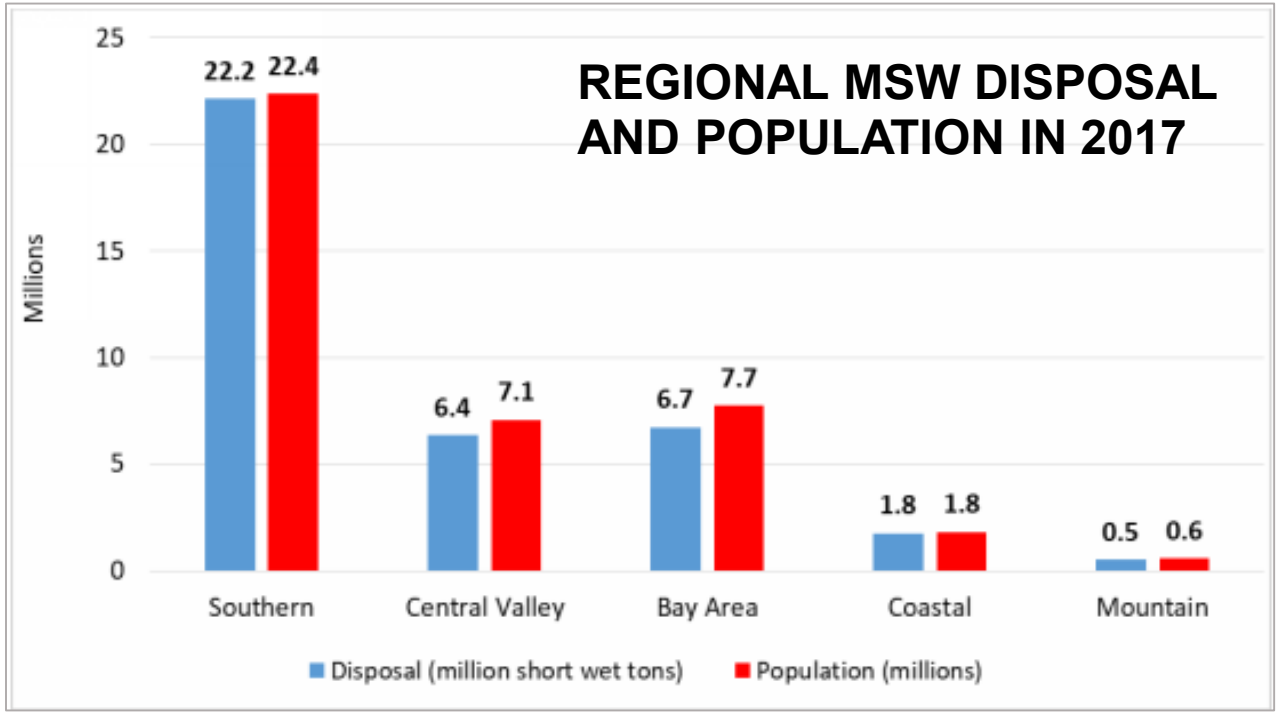
POLL QUESTION

Chapter 1-Food Waste Disposal Analysis

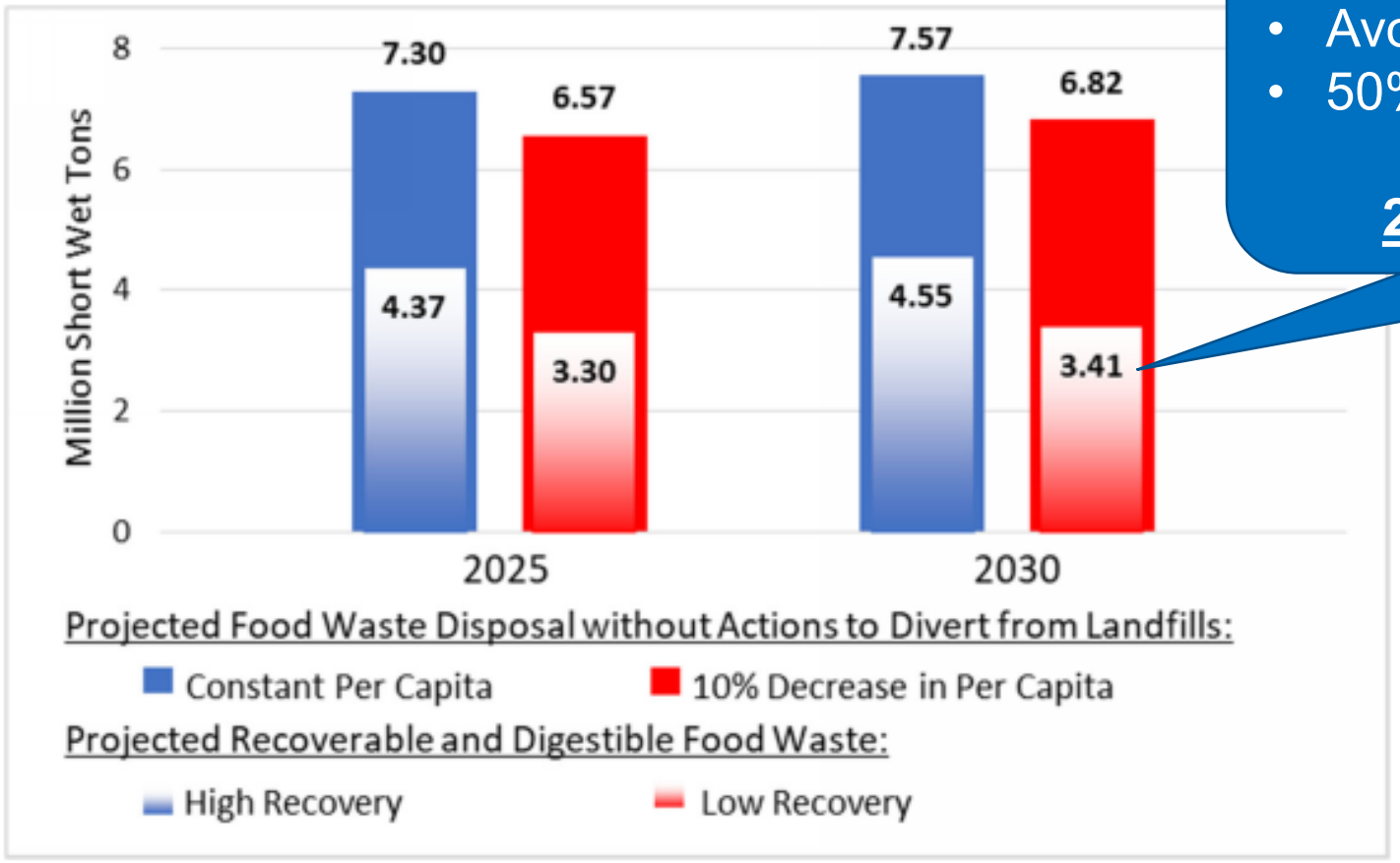
// Municipal solid waste (MSW) includes ~18% food waste, disposal follows regional population



Ref: Cascadia 2015

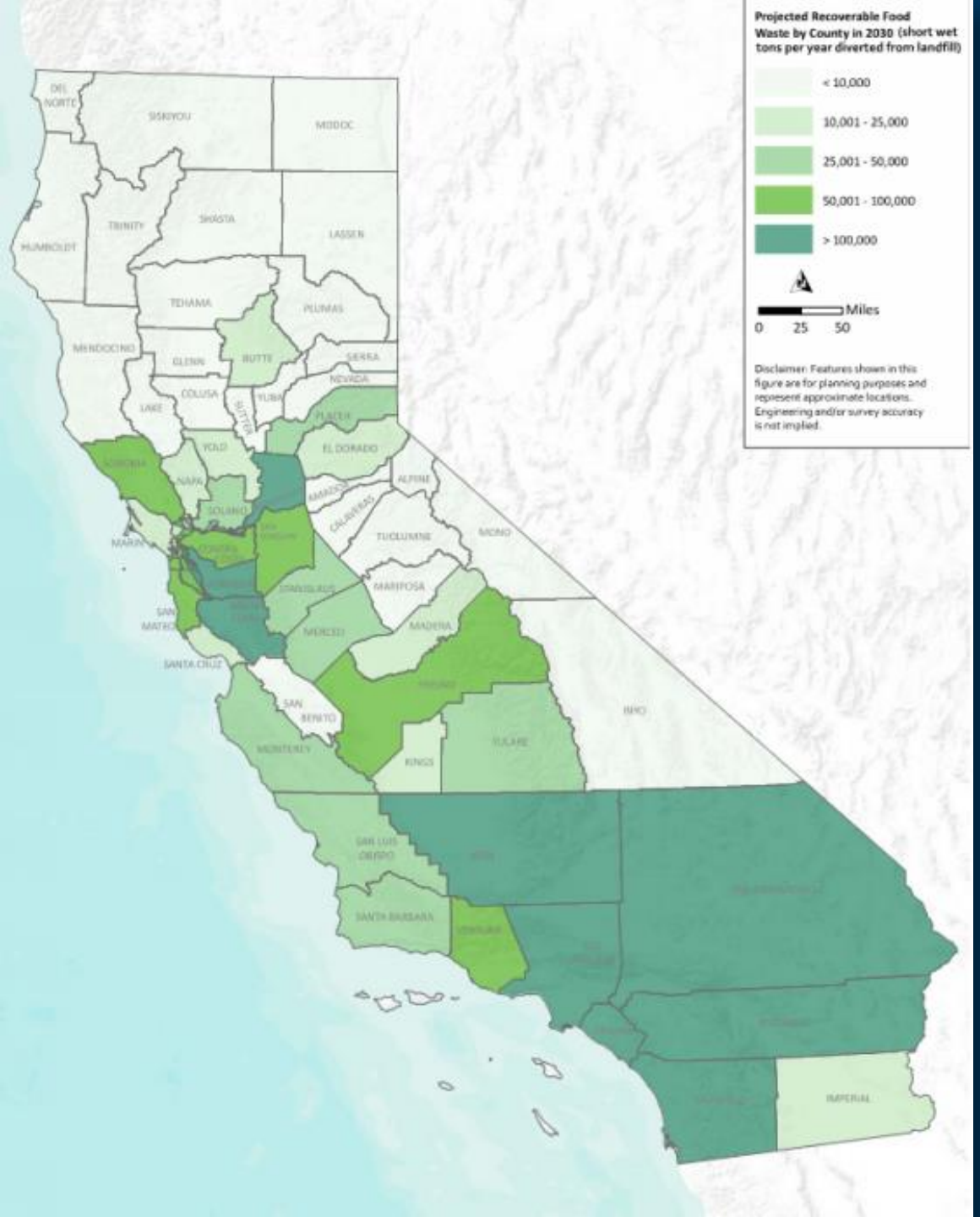


// State's population and waste data used to determine per capita food waste and future projections



- Allow for continued reduction in per capita disposal/recession
- Avoid over-estimating GHG reduction
- 50% recovery of digestible food waste

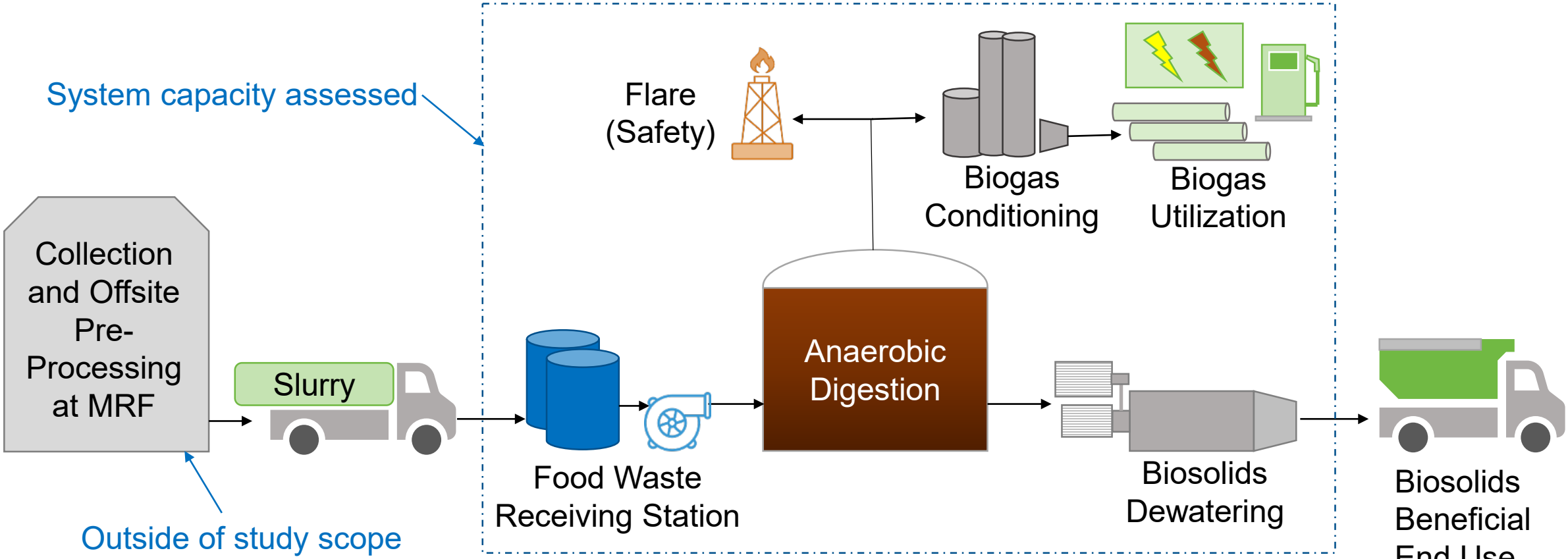
2030: 3.4 MILLION WET TONS



Food waste comprises ~18% of MSW and 30% of total organics disposal, so diversion can play a major role in meeting state's SB 1383 goals

Chapter 2- Analysis of Existing Capacity for Co-Digestion

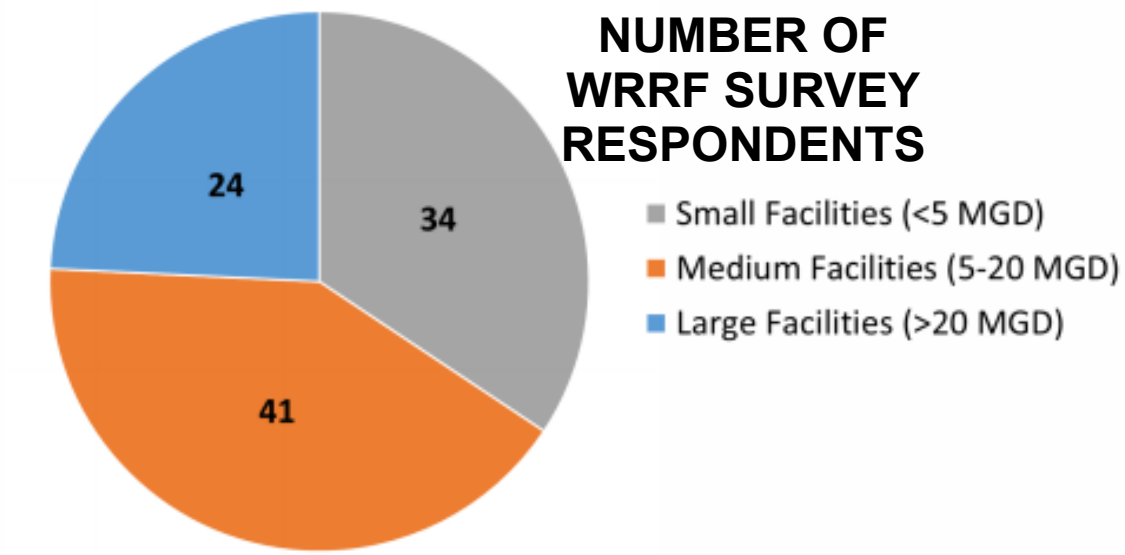
// Key processes required at WRRF to accept food waste slurry, co-digest, and beneficially use byproducts



Co-Digestion System Components Within WRRF

// Comprehensive survey for CA WRRF's solids and biogas systems developed, distributed, and results analyzed

- Survey focused on solids systems
- 99 of 223 WRRFs responded
- Represents ~80% of state's total WRRF design flow capacity



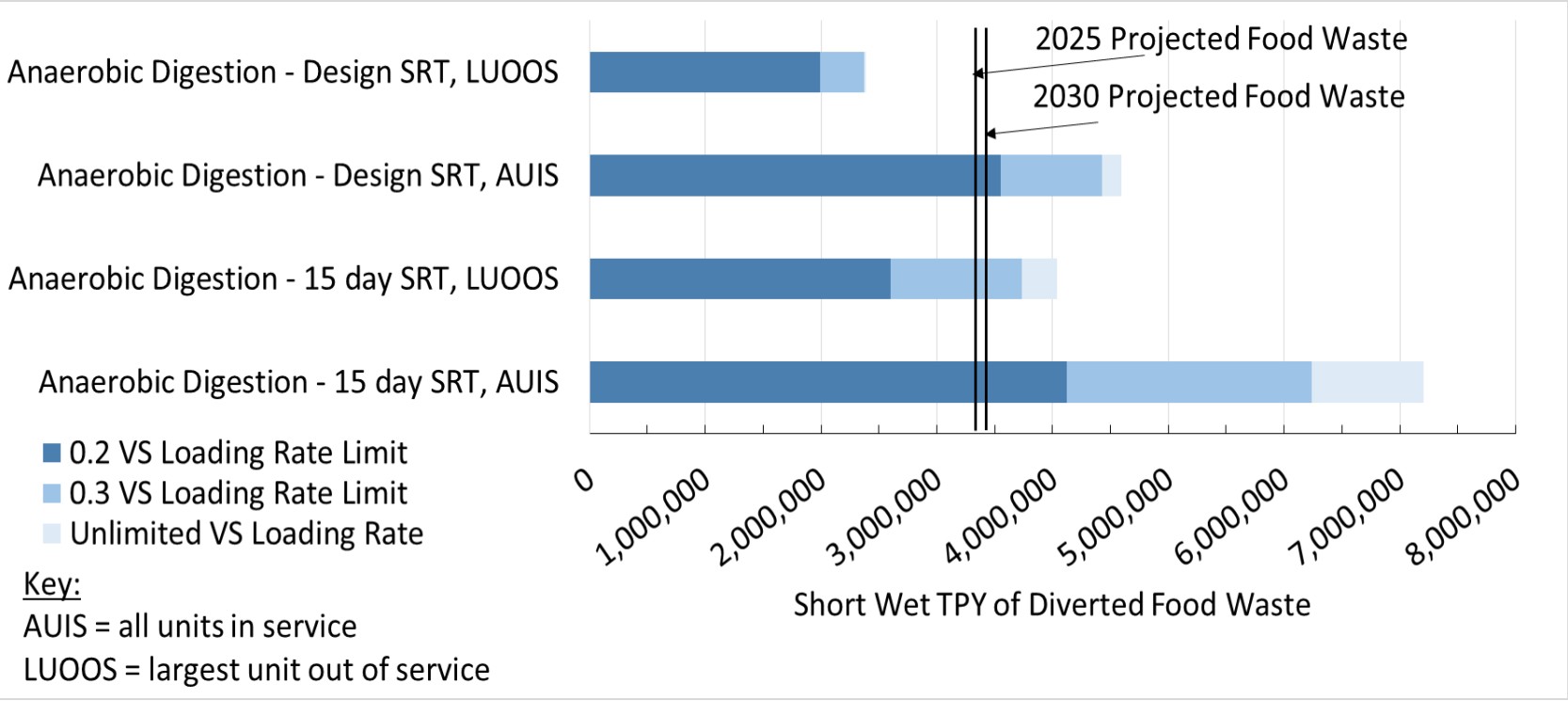
// Compared current/projected loads to existing capacity to identify excess capacity in key processes

- Excess capacity reported as “short wet tons/year diverted food waste” to illustrate statewide impact for organics diversion

Food waste diverted to MRFs: ~30% TS

Slurry delivered to WRRFs: 12-18% TS
Assumed value of 15% TS for study

// Digestion capacity considered various operating scenarios

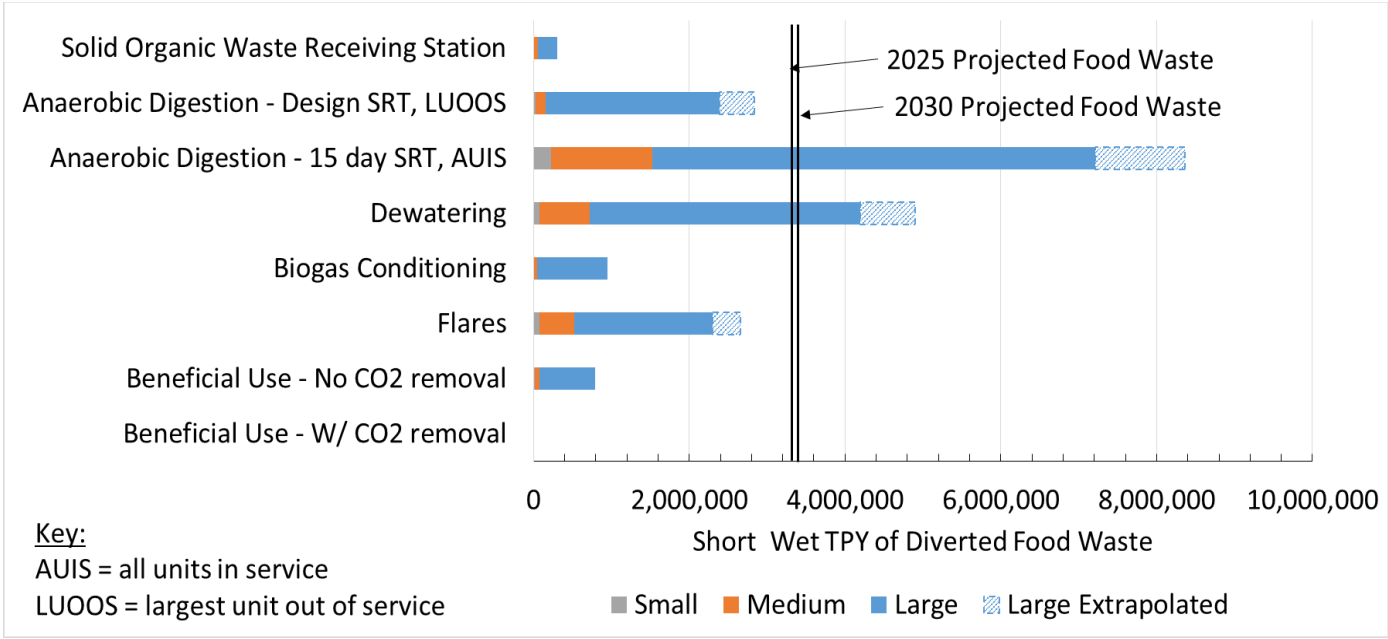


STATEWIDE EXISTING EXCESS DIGESTION CAPACITY

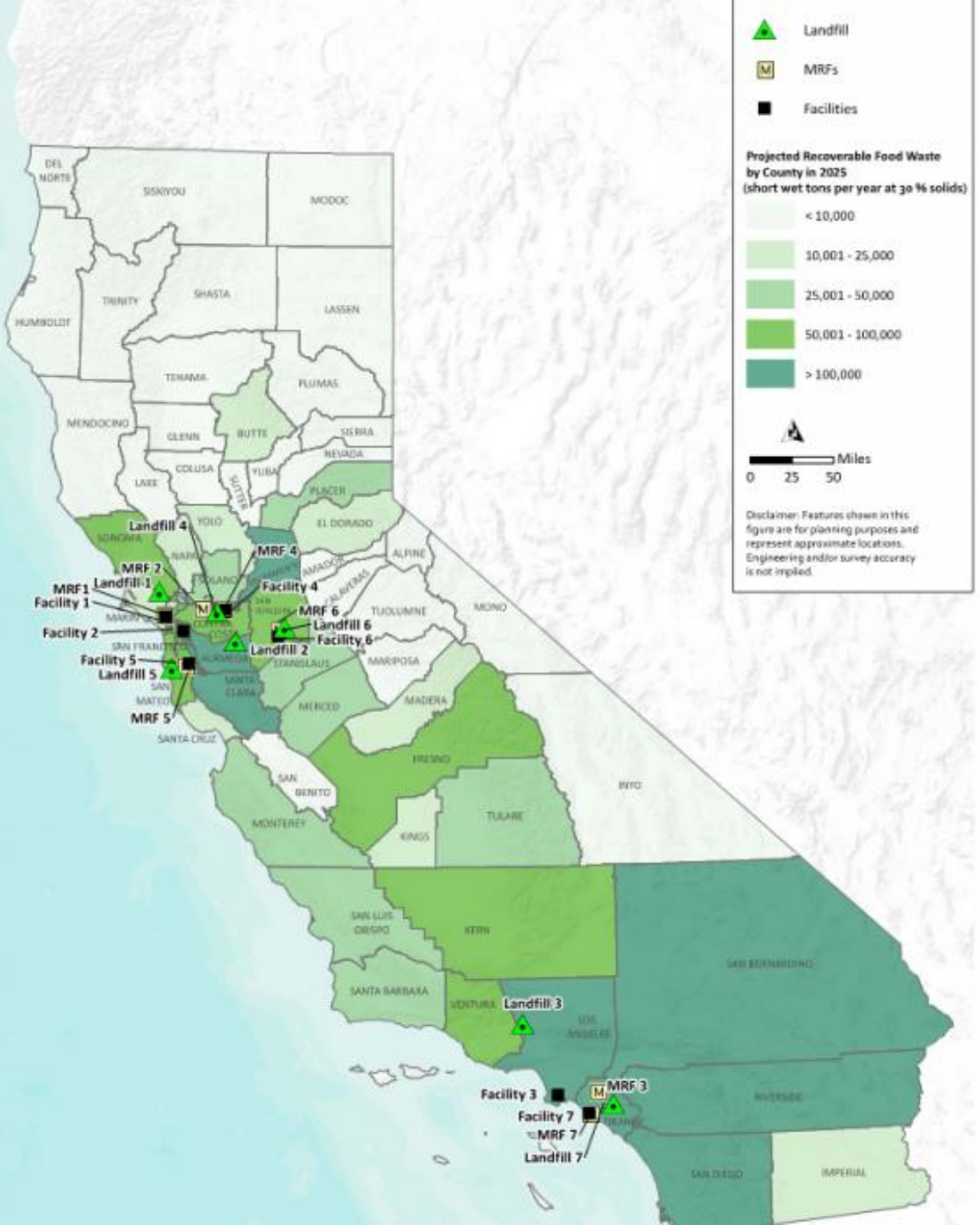
- SRT
- Redundancy
- Organic Loading Rate

// Capacity for specific processes at large facilities extrapolated to cover plants that did not respond

- Extrapolation only for processes that scale with influent flow
- Sufficient digestion capacity for most diverted food waste at 2030
- Overall capacity limited by other processes
- Significant capacity limitations in receiving stations and biogas systems



STATEWIDE EXISTING EXCESS CAPACITY FOR KEY PROCESSES



Seven WRRFs have or will soon have all required system components

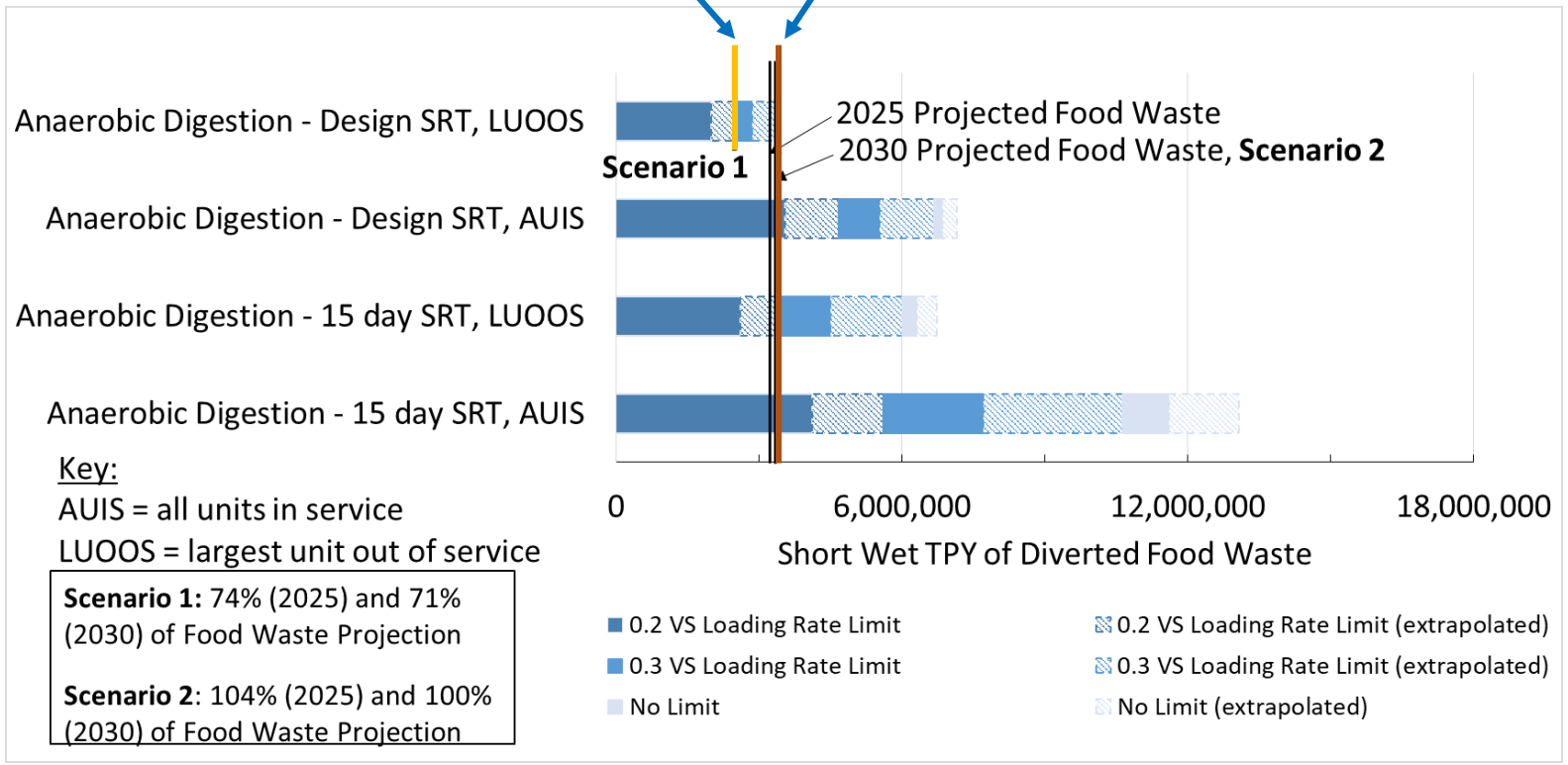
- *Limited to 118,000 wet tons diverted food waste/year*
- *3.4% of 2030 projection (3.4 million wet tons diverted food waste/year)*
- *If limiting systems expanded to match digestion capacity, could handle 846,000 wet tons diverted food waste/year*

Chapter 3- Investments to Maximize Co-Digestion

// At a statewide level, investing in other key processes leverages digestion capacity and maximizes co-digestion

Scenario 1: 2.4 Million Wet Tons/Year
Match conservative digestion ops

Scenario 2: 3.4 Million Wet Tons/Year
Projection of diverted food waste at 2030

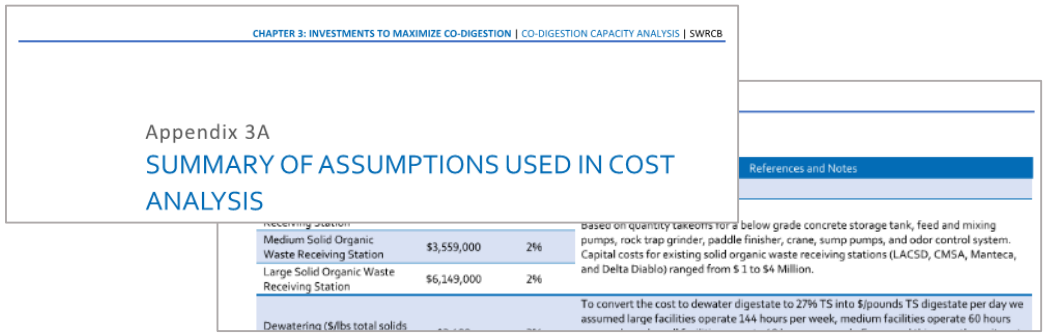


STATEWIDE EXISTING EXCESS DIGESTION CAPACITY

// Developed planning level capital and O&M costs for Scenarios 1 and 2, and an illustrative facility

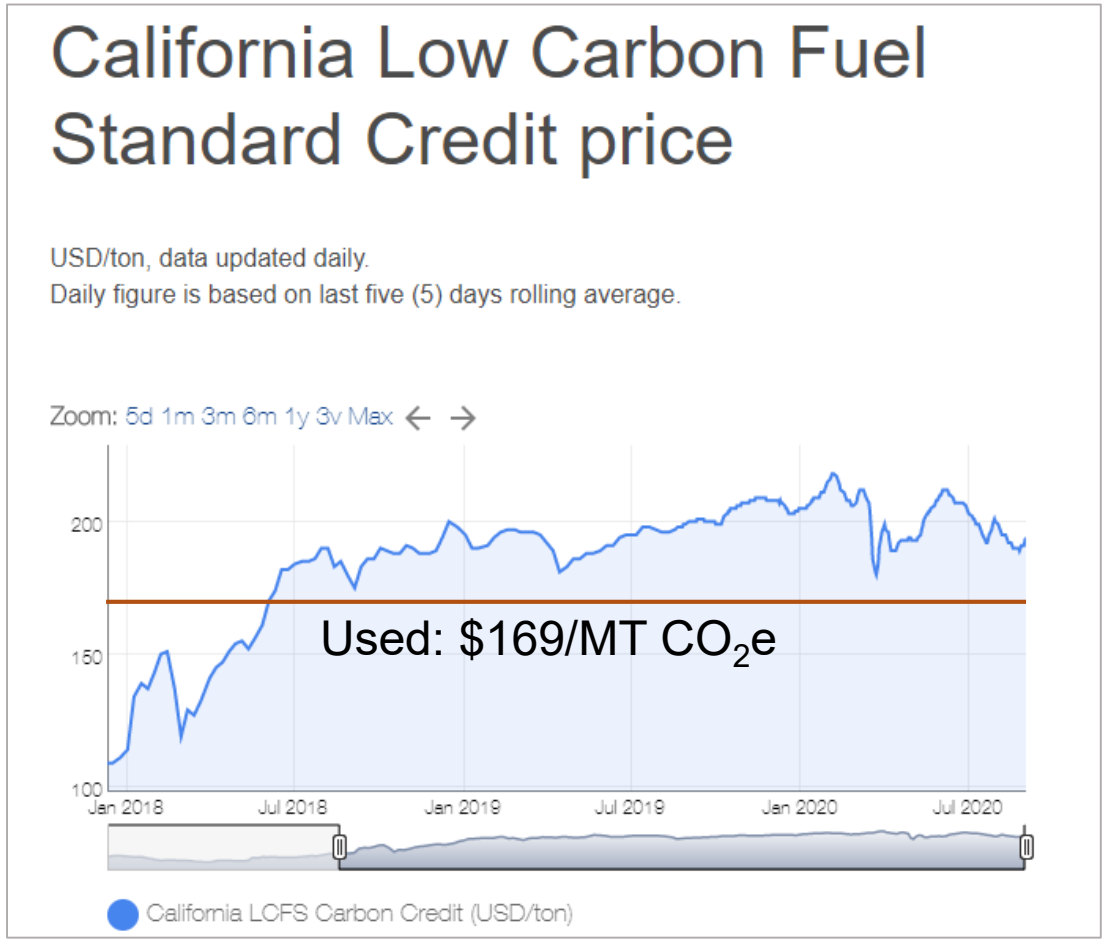
- Capital to increase capacity in key processes other than digestion
  - Unit costs for biogas and dewatering investments
  - Discrete costs for receiving stations and interconnection
- O&M – Incremental increase beyond indigenous solids treatment
  - Labor
  - Maintenance
  - Energy
  - Dewatering polymer and biosolids hauling/end use
- Appendix 3A includes cost factors and assumptions

Case	Wet Tons Diverted Food Waste/Year
Scenario 1	2,400,000
Scenario 2	3,400,000
Illustrative Facility	45,000



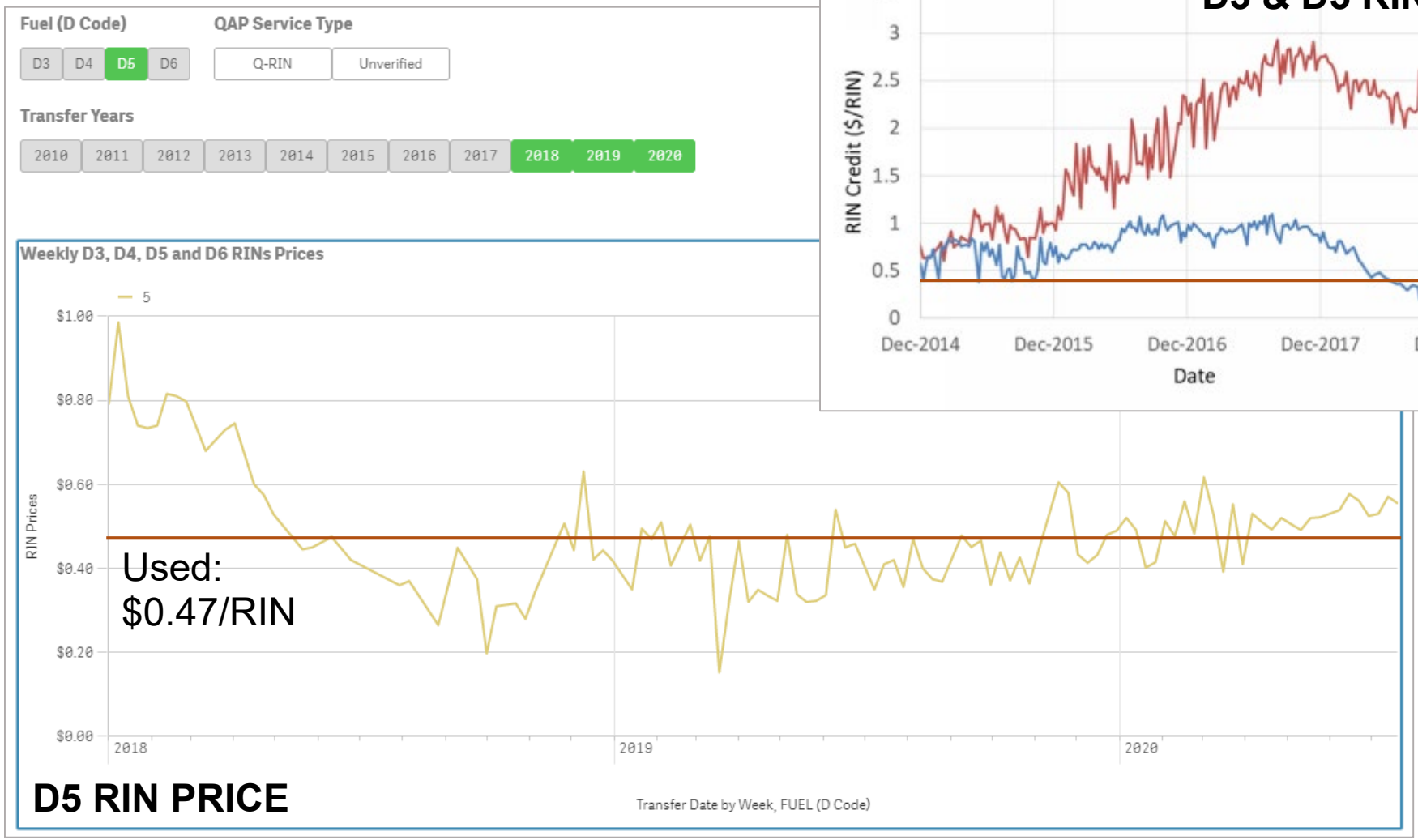
// Revenue estimates included for tipping fees and biogas utilization

- Revenues
  - Tipping fees
  - Split biogas utilization
    - Value of power and gas offset
    - Value of vehicle fuel offset
    - Value of RNG sale
    - D5 RINs, LCFS, SGIP renewable energy credits
  - **Note – these values can change and impact economics**



Source: NESTE 2020

// D5 RIN prices have declined since 2014, but flattened for past 18 months



Source: EPA 2020

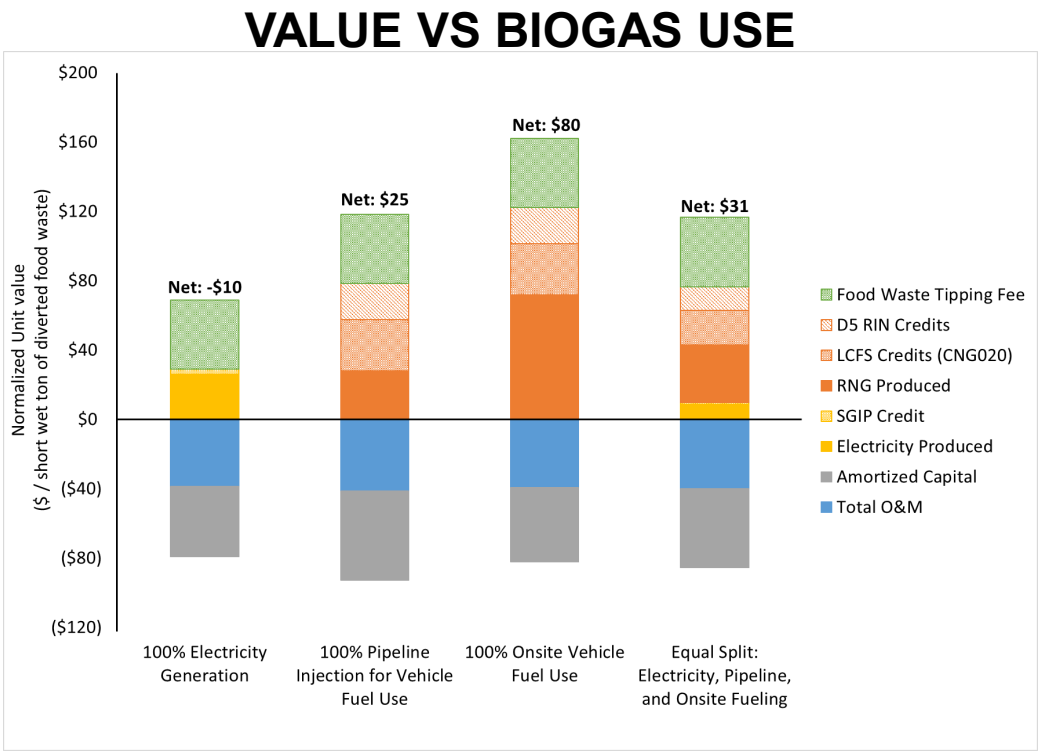
// Summary of estimated costs illustrate potential WWRF investments required and annual O&M, revenue

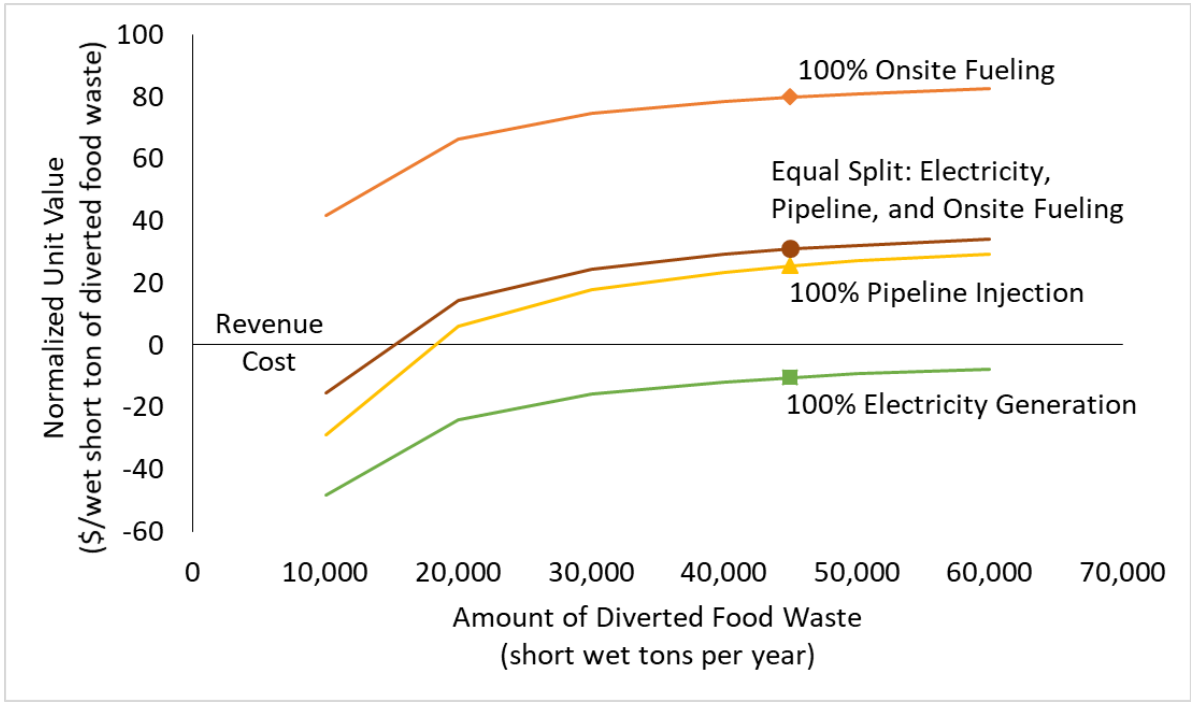
Case	Wet Tons Diverted Food Waste/Year	Coverage	Estimated Capital Cost, $M	Estimated O&M Cost, $M/Year	Estimated Revenue, $M/Year	Biogas Use
Scenario 1	2,400,000	Statewide	968	97.6	278	Split
Scenario 2	3,400,000	Statewide	1436	138	393	Split
Illustrative Facility	45,000	For Facility	22.4	1.8	7.3	CNG Vehicle Fuel

Notes:

1. *Costs do not include collection of food waste, pre-processing at MRF, or fleet conversion.*
2. *Capital costs represent planning level estimates, corresponding to AACE Class 5.*

// Conducted sensitivity analyses for various biogas utilization options, impacts of facility size, and CNG/power prices

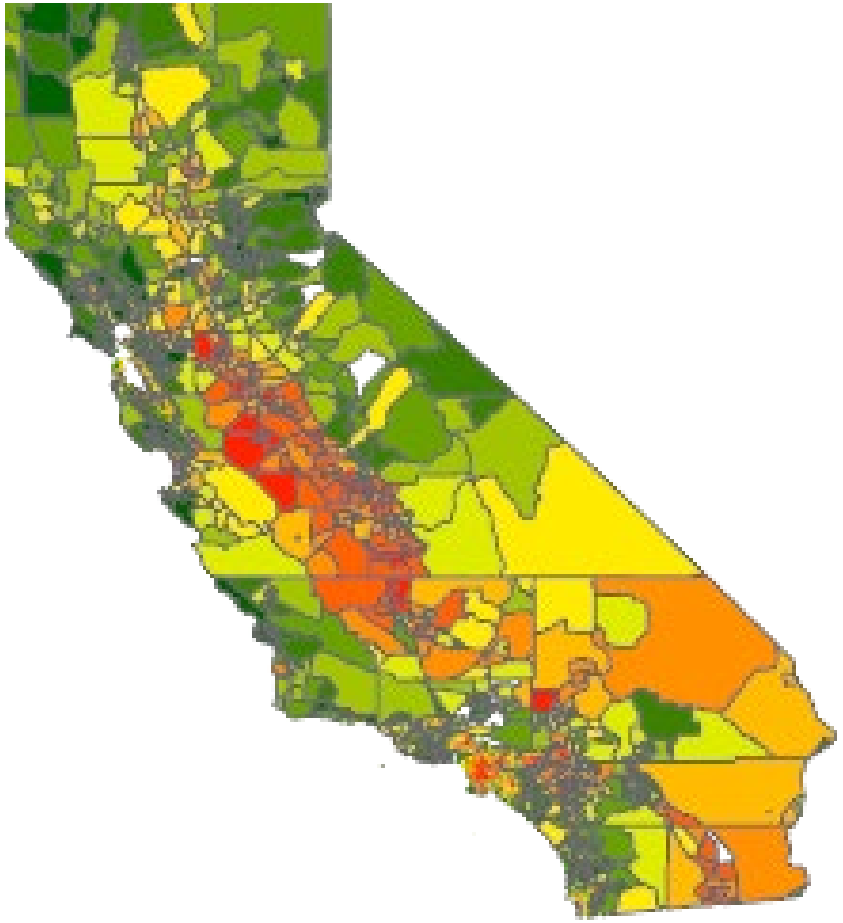




Renewable energy incentives currently favor CNG/RNG and positive economic outcomes more likely for higher-capacity facilities.

// Considered community impacts near WRRFs

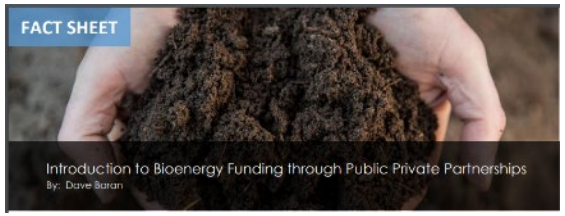
- Statewide job creation at WRRFs may be limited
  - Additional jobs possible for offsite needs
- Truck trips and noise near WRRFs would increase
- Truck trips and noise near and to/from landfills would decrease
- Odor containment and control required



Source: CalEnviroscreen

// Outlined regulatory considerations for water, air, and land that could affect feasibility

// Identified potential funding sources for bioenergy and GHG-reducing projects



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FUNDING wizard

CALIFORNIA AIR RESOURCES BOARD

IBank California Infrastructure and Economic Development Bank

CALIFORNIA ENERGY COMMISSION

CALIFORNIA Water Boards

CalRecycle

➢ *See Appendix 3G for details*

Chapter 4 – GHG Emissions Reductions

// GHG emission reduction factors (ERFs) for co-digestion follow CARB's 2017 draft methodology for compost ERFs

- Emissions
  - PE: Process Emissions
  - TE: Transport Emissions
- Emission Reductions
  - BioS: Biosolids-related Reductions
  - BioG: Biogas-related Reductions
  - ALF: Avoidance of Landfill Emissions

- Emission Reduction Factor (MT CO_2e) = Emissions Reductions - Emissions

// GHG emission reduction factors (ERFs) for co-digestion follow CARB's 2017 draft methodology for compost ERFs

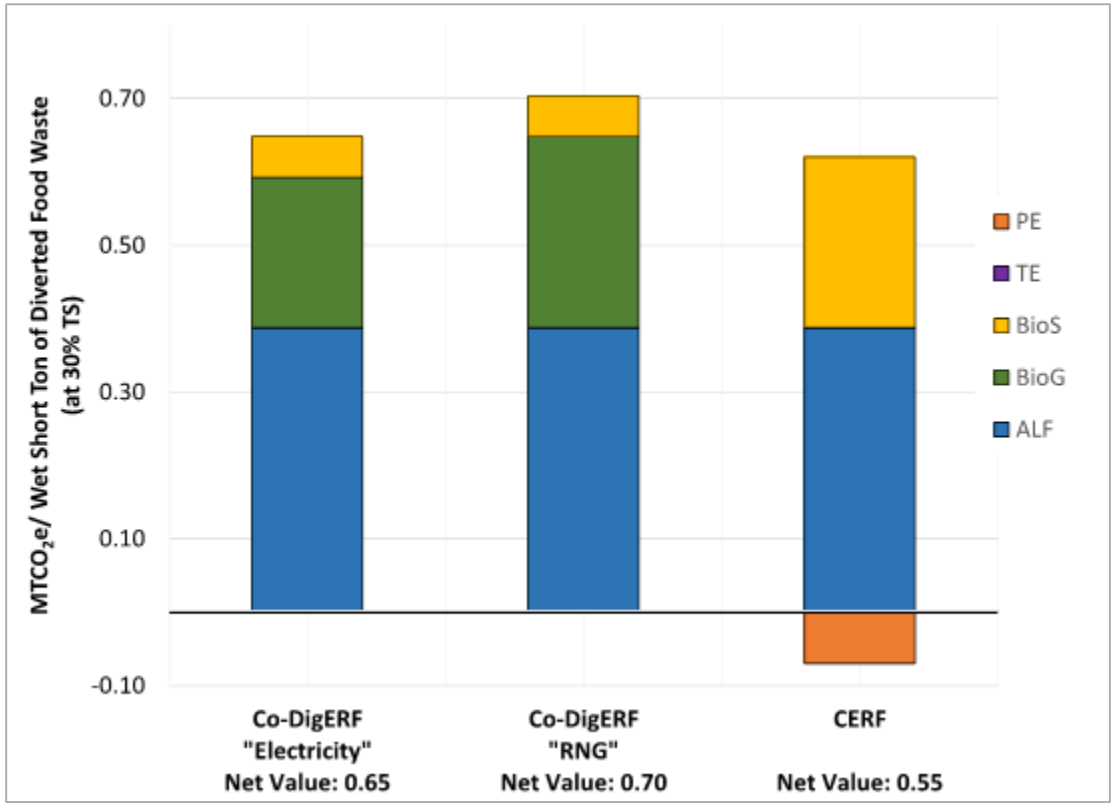
- Emissions
  - **PE: Process Emissions** – pre-processing (slurrying), add'l digester heating, and add'l dewatering energy (including polymer production and transport). Functionally equivalent to those for landfilling, this term is set to zero.
  - **TE: Transport Emissions** – transport distances and emissions similar to composting. Functionally equivalent to those for landfilling, this term is set to zero.
- Emission Reductions
  - **BioS: Biosolids-related Reductions** - associated with decreased soil erosion and herbicide use from biosolids application (C-sequestration, reduced irrigation demand, and decreased fertilizer use not included, further research needed).
  - **BioG: Biogas-related Reductions** – associated with biogas used to generate electricity onsite (cover additional demand for process support) and to generate RNG vehicle fuel.
  - **ALF: Avoidance of Landfill Emissions** – based on the decay rate of food waste in dry conditions found in SoCal.
- Emission Reduction Factor (MT CO_2e/wet ton FW) = Emissions Reductions - Emissions

// GHG ERFs for co-digestion follow CARB's 2017 draft methodology for compost ERFs

BREAKDOWN OF CO-DIGESTION EMISSIONS REDUCTION FACTORS (Co-DigERF)

Emissions Reduction Type	Emission Reduction Factor (MT CO_2e/wet ton food waste diverted from landfill)
Biosolids Use (BioS)	0.055
Biogas Use (BioG)	0.21-0.26
Avoided Landfill Emissions (ALF)	0.388
Net Emissions Reduction Factor	**0.65-0.70**

// Co-digestion appears to have a slightly greater GHG reduction potential than composting



PE: Process Emissions

TE: Transport Emissions

BioS: Biosolids-related Reductions

BioG: Biogas-related Reductions

ALF: Avoidance of Landfill Emissions

Co-DigERF:
Co-Digestion Emission Reduction Factor

CERF:
Compost Emission Reduction Factor per CARB 2017 draft report

// GHG emissions reduction from co-digestion of food waste could go a long way towards meeting the state's goals

Case	Wet Tons Diverted Food Waste/Year	Net Emissions Reductions Potential (MT CO_2e)	
		Electricity Production	RNG Vehicle Fuel Production
Scenario 1	2,400,000	1,564,000	1,696,000
Scenario 2	3,400,000	2,210,000	2,397,000

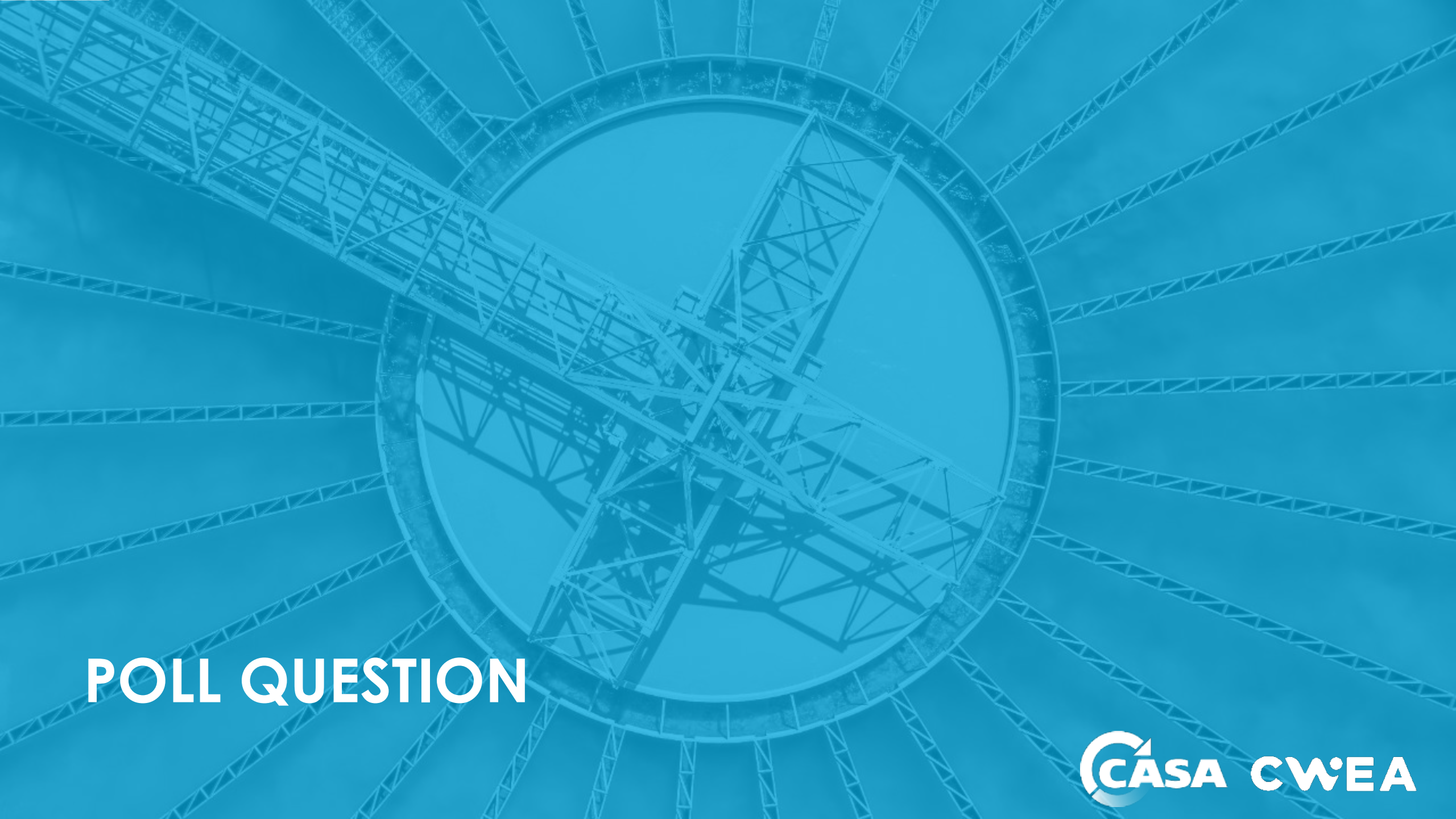
Diversion of food waste for co-digestion could reduce 1.6 to 2.4 million MT CO_2e, up to 60% of the state's goal to reduce landfill emissions by 4 million MT CO_2e by 2030.

Chapter 5 – Co-Digestion at Small/Mid-Sized WRRFs

// Case studies illustrate factors that facilitate implementation or pose barriers at smaller WRRFs

- Central Marin Sanitation Agency – 10 mgd
- Manteca Wastewater Quality Control Facility – 9.9 mgd
- Delta Diablo – 19.5 mgd
- Silicon Valley Clean Water – 29 mgd

All values noted as design average dry weather flows (ADWF)

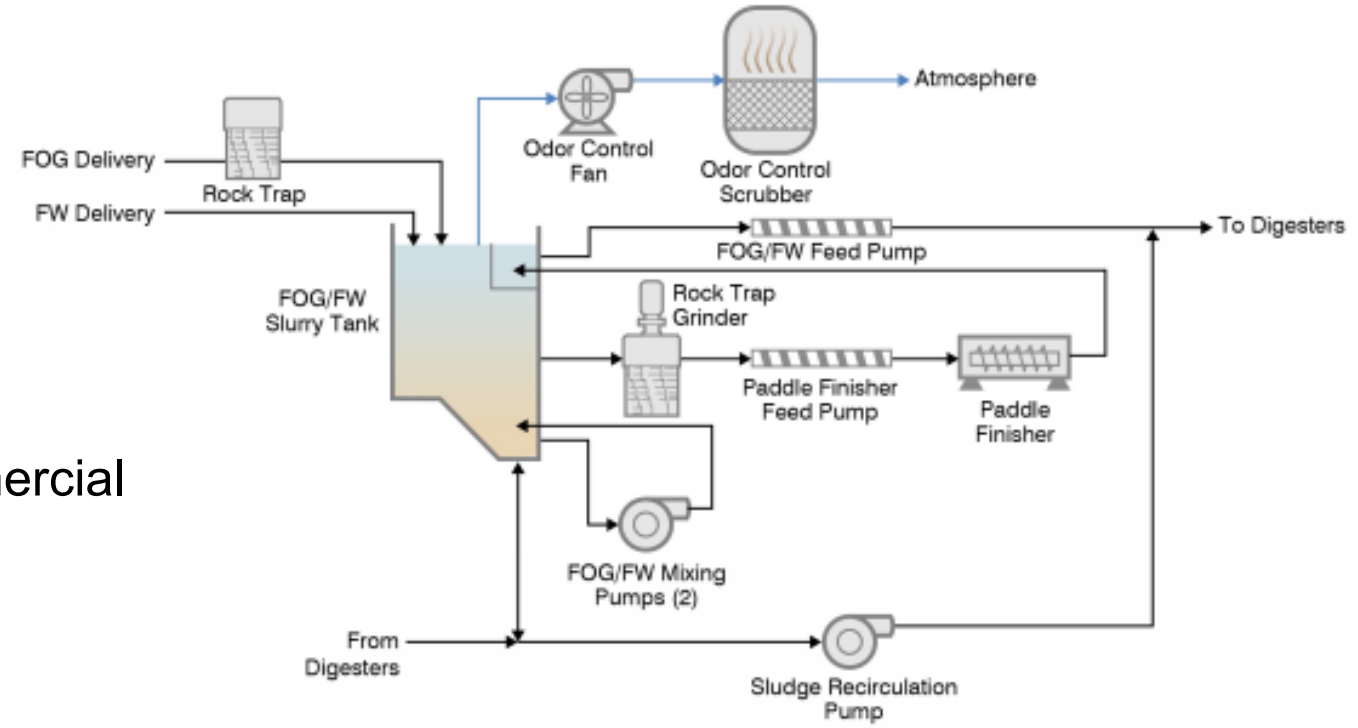


POLL QUESTION

Central Marin Sanitation Agency

// Central Marin Sanitation Agency, San Rafael, CA Food to Energy (F2E) Program

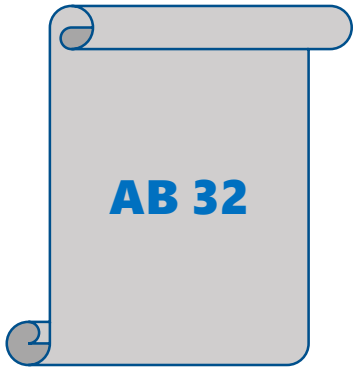
- In Marin County
- Concept developed in 2009
- Receive FOG, food waste slurry, food processing waste
  - FOG started 2013
  - Food waste started 2014
- Partnership with Marin Sanitary Services (MSS)
  - Pre-consumer source-separated commercial food waste
- Biogas used for cogeneration
- Revenue > O&M costs
- Working on modifications to export excess power to grid



// MSS collects, sorts, and processes food waste into slurry at their close-by facility and trucks it to the plant

- 6-8 wet tons/day of 18% TS slurry delivered 6 d/wk to below-grade pit
- Mixed with thinner FOG received 5 d/wk at ~15,000 gpd
- Paddle finisher to polish
- Blend fed to digesters at ~7% TS

// Factors facilitating co-digestion at CMSA



Marin Sanitary Service &
Central Marin Sanitation Agency

Central Marin Commercial Food-to-Energy (F2E) Program

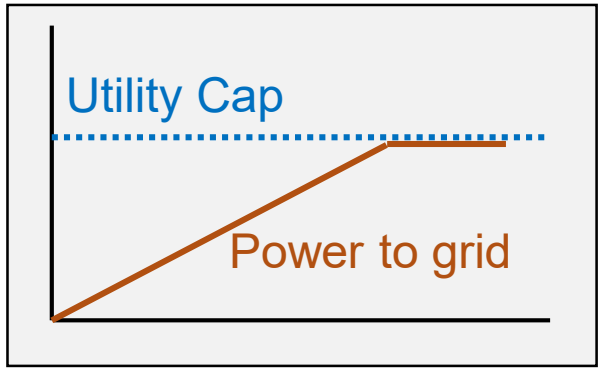
PG&E

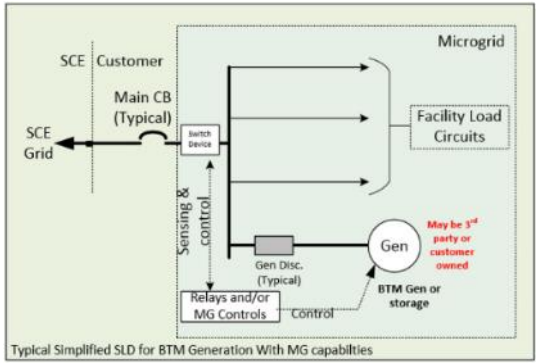
POWERED BY MCE
DEEP GREEN
100%
RENEWABLE

// Factors impeding co-digestion at CMSA

Rates to sell power to grid

Power Production Caps





Interconnect Design Features

// A few lessons learned and some advice for successful operations at CMSA...

- O&M
  - Get high quality feedstock, but still need paddle finisher for polishing
  - Maintenance has cost more than originally expected
  - Risk analysis conducted to identify critical spare parts to keep on hand
  - Coatings can fail
- Process Impacts
  - Avoid biogas flaring and digester upsets by managing digester feed and storing gas
  - Increased polymer demand to maintain cake dryness
- Assign versatile organic waste coordinator and champion

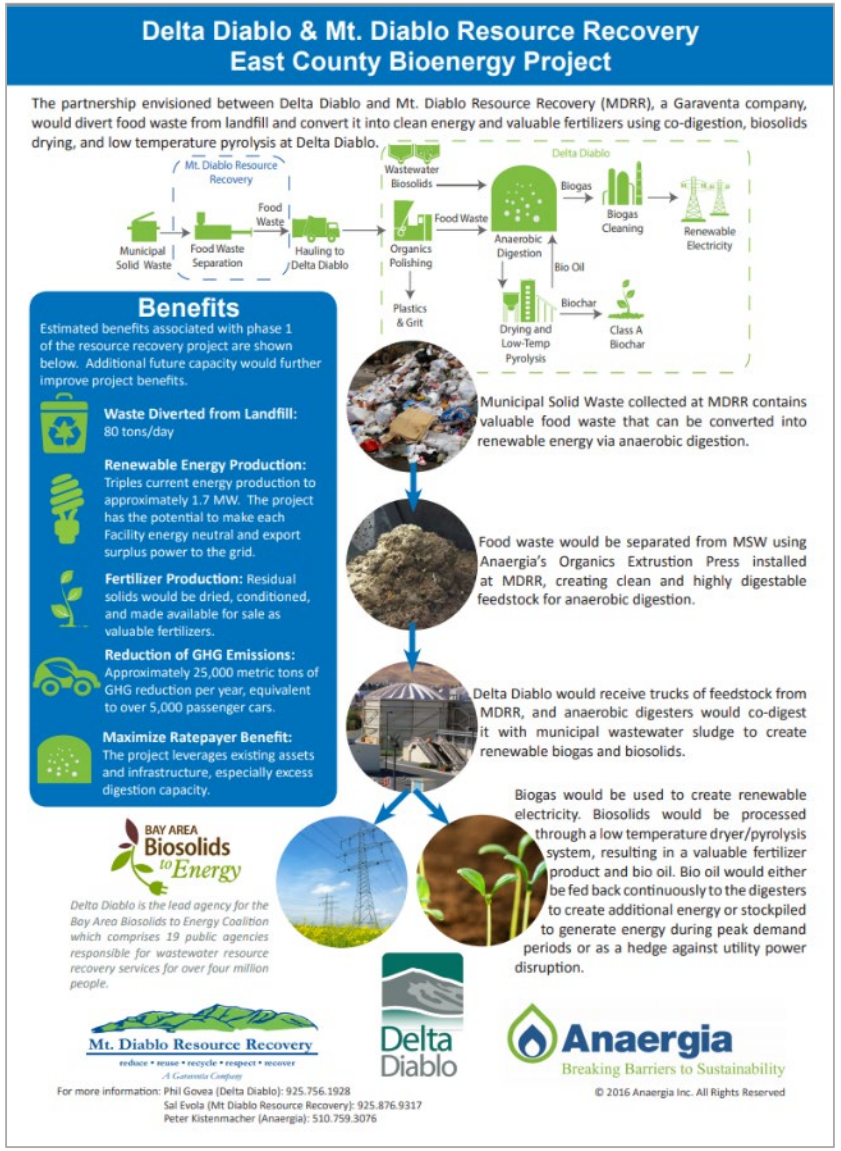
Delta Diablo

// Delta Diablo, Antioch, CA
East County Bioenergy Project

- Contra Costa County
- Planning phase of project
- Currently receives 10,000 gpd FOG for co-digestion
- Public/private partnership with Mt. Diablo Resource Recovery (MDRR)
- ECBP
  - Planned for 285 wet tons/day food waste slurry (12% TS)
  - 5 d/wk slurry delivery to plant
  - Increase power production from 0.8 MW to 2.5 MW and generate 9.4 MMBTU/hr heat energy

// ECBP includes comprehensive plan for modifications at MDRR and at WWTP

- MDRR – Pre-processing and polishing to produce organics slurry from municipal solid waste
- Slurry trucked to Delta Diablo for co-digestion
- Project elements: Digestion, food waste, biogas conditioning and utilization, flare, side stream treatment
- Owner's advisors and specialty legal assistance to help with project development



// Factors facilitating co-digestion at Delta Diablo

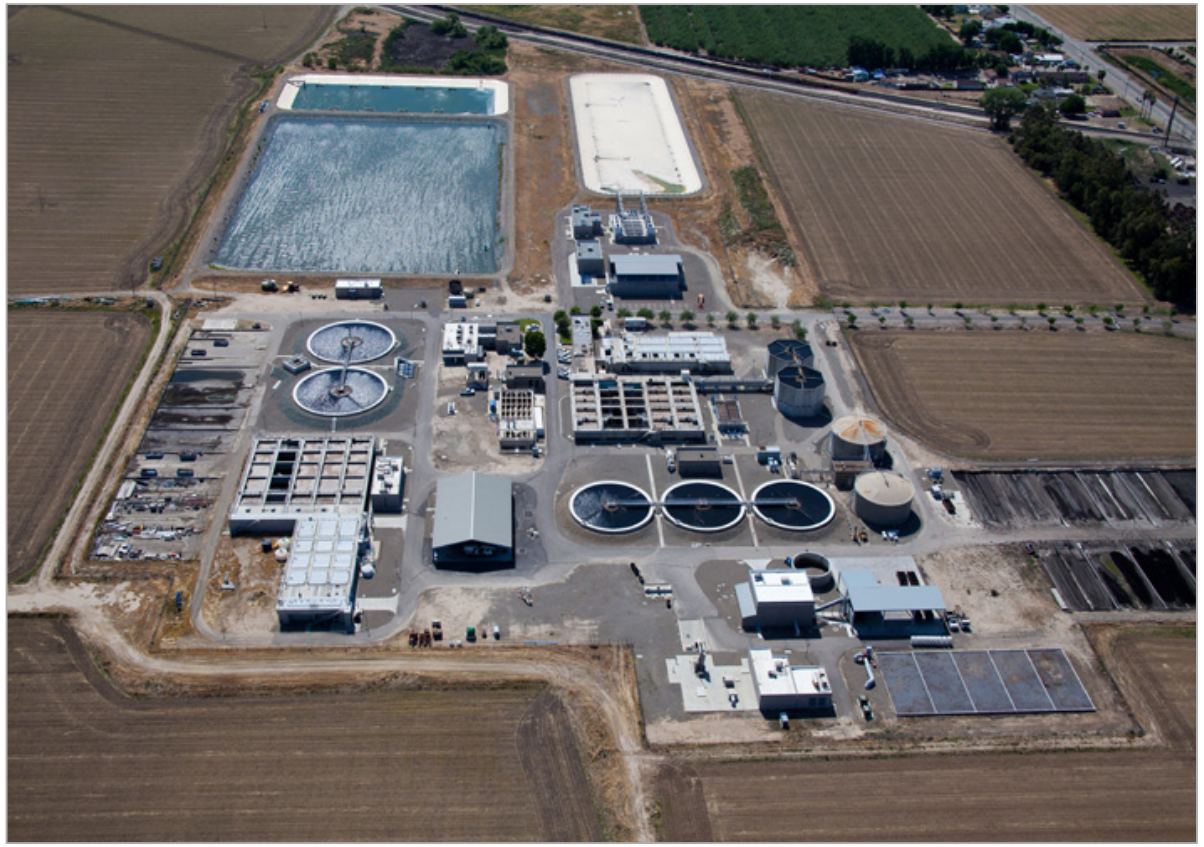
// Factors impeding co-digestion at Delta Diablo

Inadequate Funding Applying for several grants and loans	Risk Risk Register for: Technology Regulatory/Legal Construction/Start-up Operational Financial	3rd Party Coordination Regulatory Requirements Air Solid Waste Interconnection/PPAs

Manteca Wastewater Quality Control Facility

// Manteca WQCF, Manteca, CA Waste to Fuel Program

- In San Joaquin County
- Five projects under construction at time of report completion
  - Project 1: Digester and Digester Control Bldg Improvements
  - Project 2: Food Waste Receiving
  - Project 3: FOG Receiving
  - Project 4: Compressed Biogas Fueling Facilities
  - Project 5: Food Waste Separation Project
- Upon completion, capacity for 3,400 wet tons food waste slurry per year



// Factors facilitating co-digestion at Manteca

Organic Diversion Regulatory Drivers
AB 341
AB 1826
SB 1383
Impacts on biosolids management

Proximity to CNG Fueling Station
Four old trucks need replacement

Financing
City Funds/Bonds
CEC Grant
SJVAPCD Grant

Air Quality Regulatory Drivers
SJVAPCD limits
Impacts on boilers and flare

Partnerships
City: WWTP, Solid Waste
County: MRF

Diesel Truck Regulatory Drivers
CARB diesel truck emission limits
Impacts on aging truck fleet

Planning Reports
Biosolids/Biogas
Solid Waste

// Factors impeding co-digestion at Manteca

Inadequate Funding
Equipment Procurement
RIN Revenue Potential

Regulatory Hurdles
Biosolids land application restrictions
Development of SOP
Nitrogen load vs limits

Silicon Valley Clean Water

// Silicon Valley Clean Water, Redwood City, CA

- San Mateo County
- Operated food waste co-digestion pilot for 3 months
  - Accepted 3-6 wet tons/day of slurry from organics extrusion press
  - “Black bin” source
- Intend to proceed with full scale implementation
  - Receive extruded (and hopefully polished) organics from MSW

// Modified existing FOG receiving system for pilot test

Image Source: Anaergia

Recology's organics extrusion press used to produce food waste for plant

- Repurposed 1 of 2 sub-grade FOG tanks to receive food waste
- Dilution water
- Mixing
- Feed pump for slurry
- Paddle finisher (added due to contamination)
- Storage tank for "clean" slurry
- Existing pump to feed slurry to digester

// Factors facilitating co-digestion at SVCW

Plans and Pilot Testing
Energy Master Plan
Food Waste Co-Digestion Pilot

Supportive Partnerships
Memorandum of Understanding (MOU) with South Bayside Waste Management Authority

Shared Objectives with SBWMA

Available Equipment
Organics Extrusion Press moved to SBWMA

Financing
CalRecycle Grant for Equipment Procurement
CEC Grant for Technology Demo

// Factors impeding co-digestion at SVCW

Regulatory	Contamination
Air permitting took 2 years to resolve Solid waste permit due to “black bin” nature Could be granted exclusion from solid waste permit	15-20% contamination in extruded food waste received Time-consuming Need polishing

// A few lessons learned from SVCW…

- Securing agreement early with waste management firms/partners is important
- High quality feedstock is essential for reliable operations
- Screen type on paddle finisher important for reliable performance and secure enough bins for contaminants
- Delivery vehicles can vary in size – plan accordingly
- Preliminary results showed more biogas production and easier dewatering – full results should be available now

Common Factors Facilitating Co-Digestion

- State laws and regulations drive change
- Supportive partnerships with waste management firms and utility providers
- Board/community support
- Robust planning/feasibility studies
- Financing assistance through loans/grants
- Revenue/cost offsets through tipping fees and biogas utilization

Common Barriers Impeding Co-Digestion

- Regulatory hurdles – effluent, air, solid waste
- Insufficient planning/feasibility
- Inadequate funding and uncertainty about revenue
- Feedstock contamination
- Competition for organics diversion through composting and impacts on tipping fees

Chapter 6 – Co-Digestion at Large WRRFs

// Case studies illustrate benefits and challenges associated with co-digestion

- East Bay Municipal Utility District (EBMUD), Main Plant – 120 mgd Design ADWF
- Sanitation Districts of Los Angeles County (LACSD), Joint Water Pollution Control Plant – 400 mgd Design ADWF

All values noted as design average dry weather flows (ADWF)

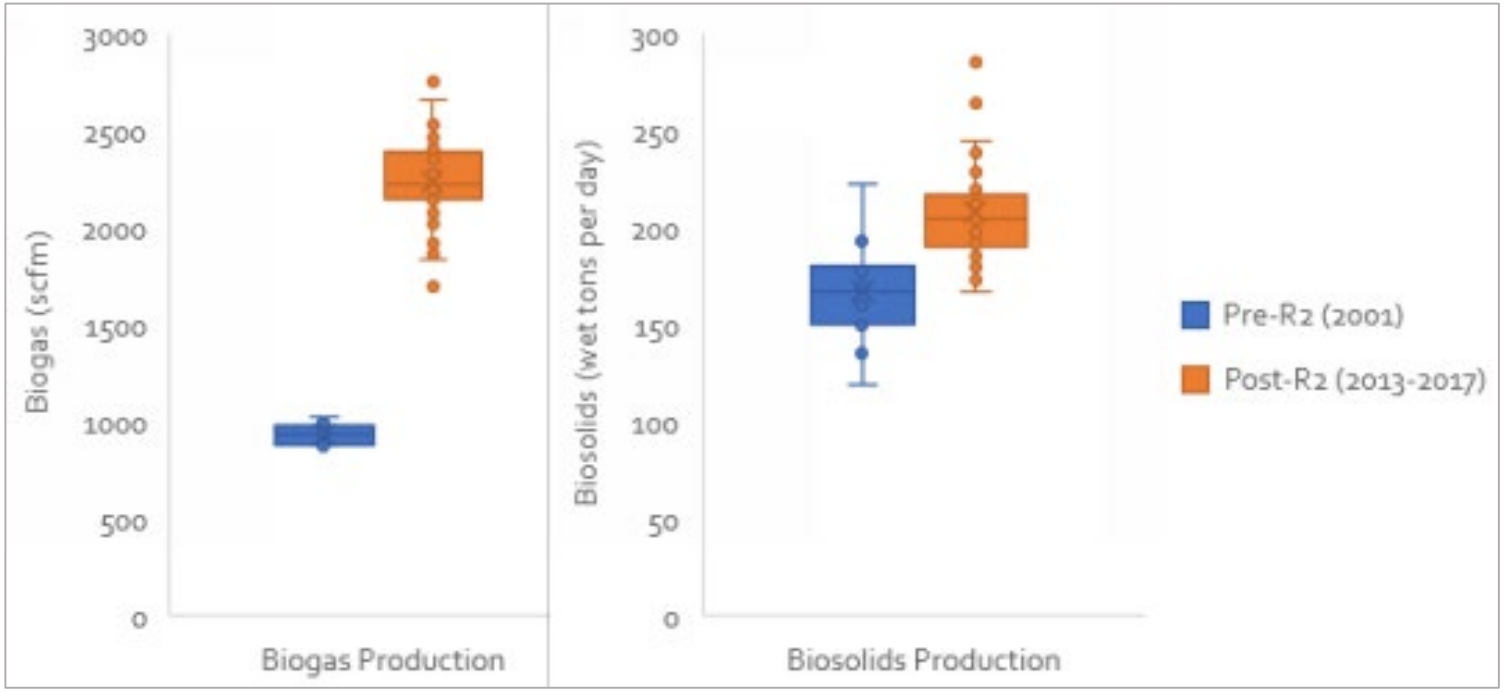
EBMUD, Main Plant

// EBMUD's well-known Resource Recovery program leverages excess capacity for organics loads

- Thermophilic operation in 11 available digesters
- Three 2.1 MW engines and one 4.5 MW gas turbine for cogeneration
- Net energy positive on average
- Resource Recovery (R2) program includes variety of organic feedstocks for co-digestion
- Food waste slurry currently comprises small portion of overall feed

// EBMUD's R2 program has produced tipping fee revenue and energy that exceeds added costs for biosolids

- 100-150 trucks/day with all R2 feedstocks
- Significant revenue
  - $1M/yr tipping fees
  - $2M/yr power offset
  - $1M/yr power sales
- Biogas and biosolids production increased
  - $1M/yr increased biosolids costs



// EBMUD continues to address challenges posed by R2 program

- Impacts on nitrogen and TDS in effluent
  - Nitrogen removal likely required regardless of R2 program
  - Salinity can limit use of recycled water
- Variable biogas production impacts utilization equipment even with feedstock blend, continuous feed, and low-pressure biogas storage
  - Considering incentivizing R2 deliveries on weekends
- Value of wholesale electricity decreasing, shifting economics of biogas utilization
- RNG for pipeline considered, but impacted by OSHA regulations
  - Recent communications with Cal-OSHA may have improved this
- Grit/abrasive debris in FOG and food waste increases O&M
  - Testing grit removal from 6% TS slurry

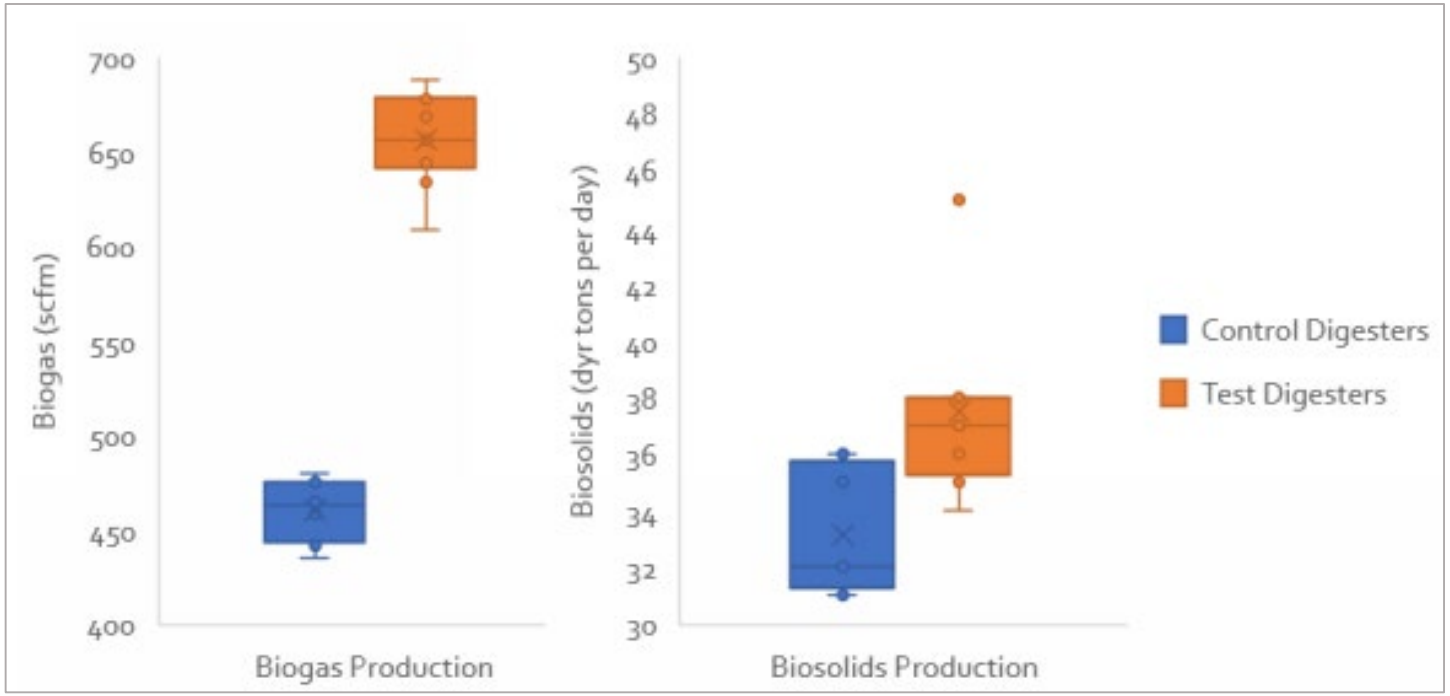
LACSD – Joint Water Pollution Control Plant

// Joint WPCP conducted long-term demonstration of food waste slurry co-digestion to study impacts

- Mesophilic operation in 24 available digesters
- Biogas utilization
  - Five IC engines
  - Five boilers
  - Three gas turbines
- Demonstration preceded by feasibility study and bench scale testing
- Partnered with Waste Management for acceptance of source-separated commercial organics
  - Engineered bioslurry produced offsite and trucked in
- Demonstration: 2/2014-12/2017

// Demonstration proved successful and LACSD has built pre-processing system at District MRF

- During demo, received up to 70 wet tons/day of bioslurry
  - Started slowly, ramped up
- Four digesters dedicated to demo
  - Two control and rotation of other two as test or control
- Primary challenge during test: grit, glass and associated O&M
  - Considering ways to improve removal in slurry
- Vehicle fueling system project underway
- Will construct larger slurry receiving station next

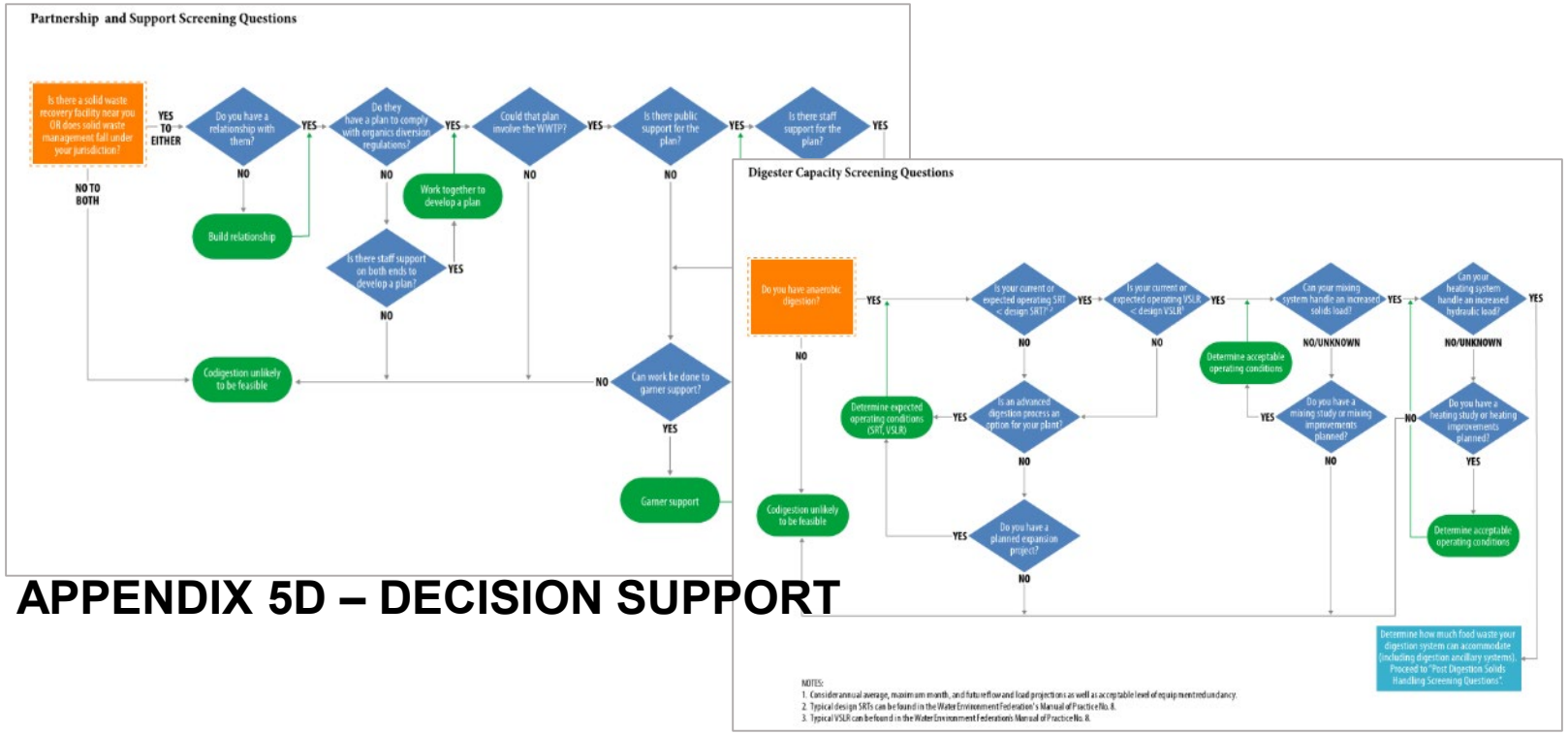


Results represent data from September-November 2016

Closing

POLL QUESTION

// Co-digesting food waste slurry at WRRFs can help achieve CA's mandates/goals if challenges & investment needs are addressed



APPENDIX 5D – DECISION SUPPORT

Feasibility of co-digestion and biogas utilization options at facility level requires case-by-case assessment

Thank you for your time!

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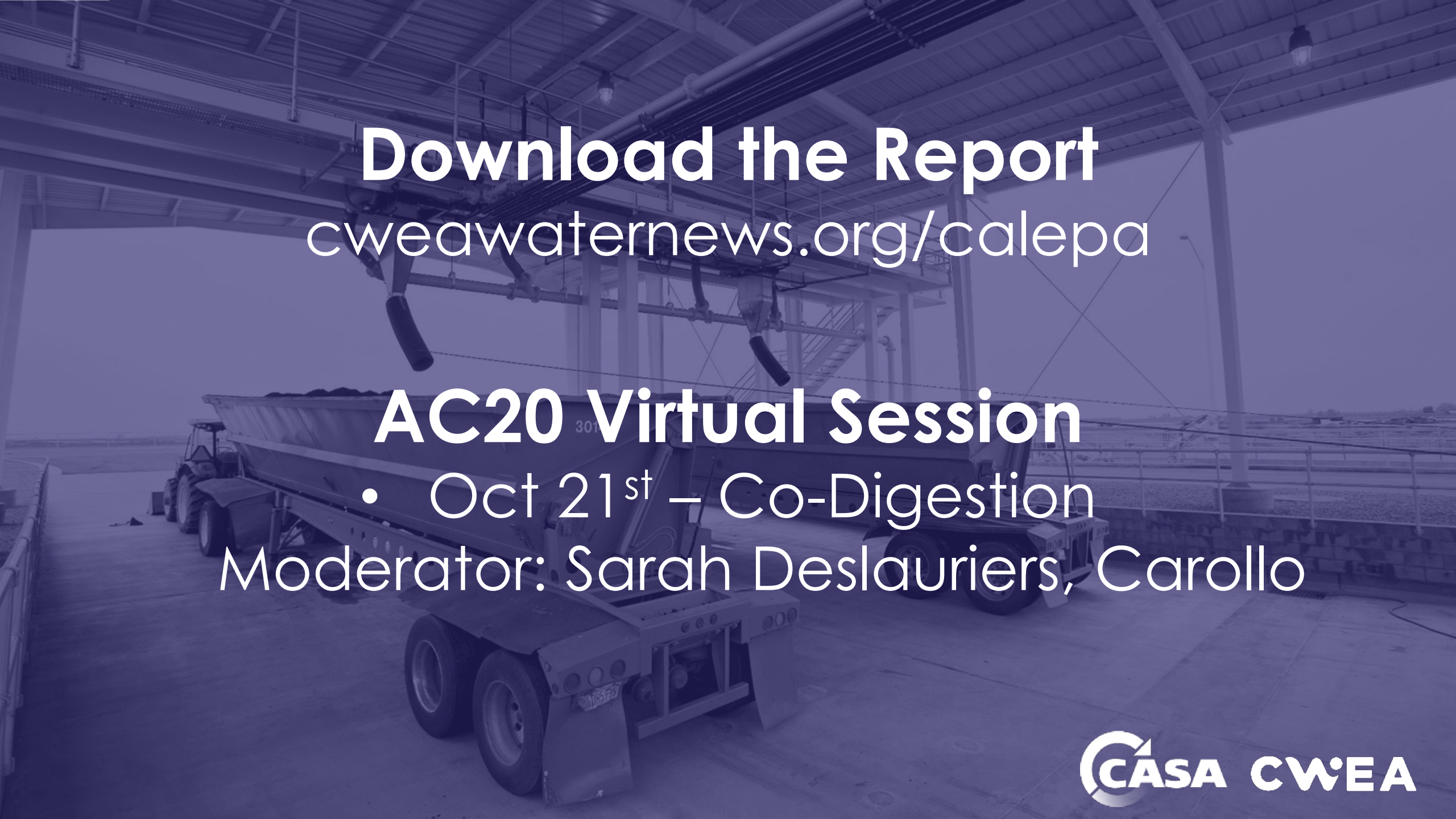
Please contact us with questions or if you'd like an electronic copy of the report.

Q&A



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AC20 Virtual Session

- Oct 21st – Co-Digestion

Moderator: Sarah Deslauriers, Carollo

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Thank You!