EAST BAY MUNICIPAL UTILITY DISTRICT

EBMUD's Renewable Energy Initiatives

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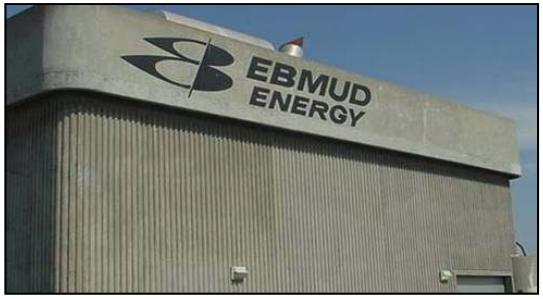


Presentation to:

Metropolitan Water Reclamation District of Greater Chicago

September 30, 2011

Topics

- Historical overview of the role of WW utilities
- A new role and the driving forces
- Introduction to EBMUD
- Renewable energy efforts
- Renewable energy credits and greenhouse gas offsets
- Looking forward
- POTW as a “green factory”

Historical Roles for Wastewater Utilities

- Protector of public health
- Protector of the environment

Historical Evolution of Concerns and Wastewater Treatment Objectives

Period	Major Concern	Wastewater Treatment Objectives
Pre-1970	Waterborne disease and protection of human health	Eliminate pathogens with treatment and disinfection
1970-2005	Degradation of aquatic environment with impacts to wildlife	Reduce pollutant loading to receiving water bodies
2005 onward	1) Resource scarcity and costs 2) Climate change	1) Resource recovery from waste materials 2) Reduce carbon emissions

A New Role Emerges: Waste to Energy

Biodiesel

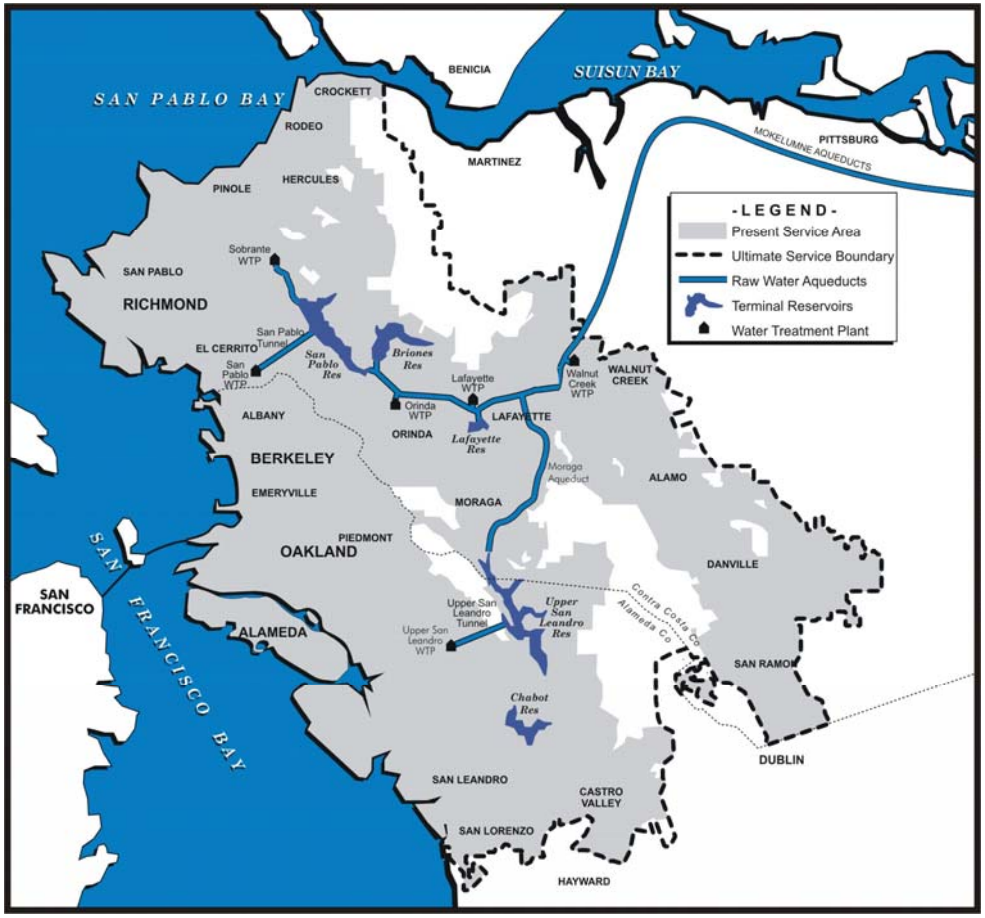
Biogas

Driving Forces

- Commodities pricing – escalating rapidly with developing nations growing demand
- Climate change – pressure to use fewer fossil fuels

East Bay Municipal Utility District

- Regional water and wastewater public agency serving the east San Francisco Bay
- Drinking water system serves 1.3 million people
- Wastewater system serves 650,000 people



Hydroelectric Power

- Two Hydropower Plants
  - Pardee 30 MW
  - Camanche 10 MW

- Production ~ 185,000MWh/yr
- Offsets ~ 70,000MT/yr CO_2

Existing On-site Generation

- Three 2.2-MW IC engines
- Avg. output is about 3.0 MW
- Historically met ~40% of plant load

New Renewable Energy Efforts

Photovoltaic Solar Facilities

- Sobrante ~ 600,000 kWh/yr
- Adeline ~ 40,000 kWh/yr
- PV Power Purchase Agreements
  - 5 locations
  - Total of ~1,290,000kWh/yr

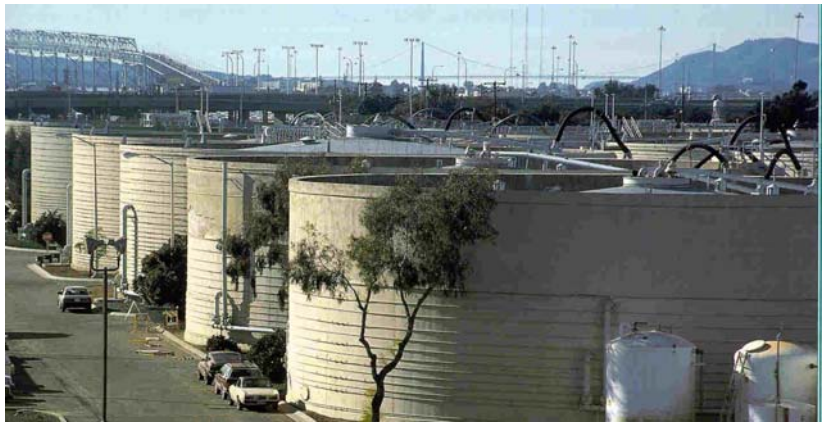
Microturbines

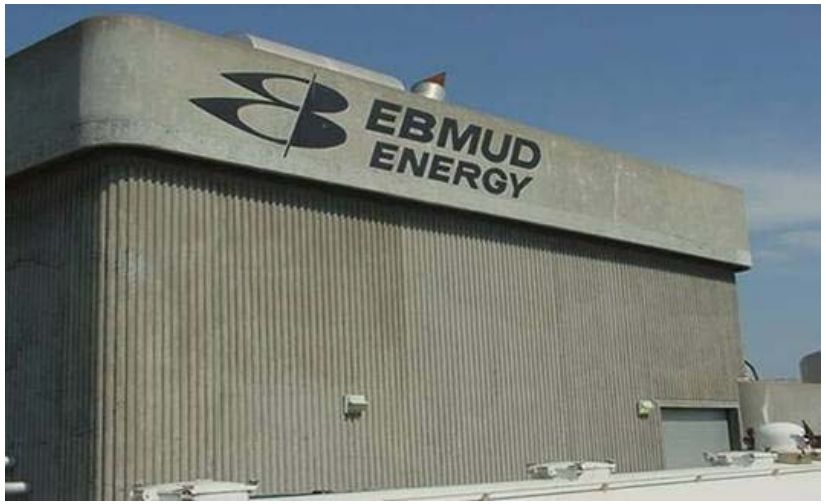
On-site cogeneration for office buildings

Resource Recovery (R2) Program

Unique Conditions at EBMUD

- Excess digester capacity available
- Plant site on network of major interstate highways
- Economies of scale
- Limited alternatives in major urban area
- In-house expertise to perform research





Waste Examples

- **Started with:**
  - Septage
- **Progressed to:**
  - Fats, oils, and greases (FOG)
- **Expanded program includes:**
  - Food processing waste
  - Winery waste
  - Industrial/commercial process waste
    - Well purge water
    - Tank rinsate
  - Animal processing waste
    - Chicken blood
    - Beef blood
    - Turkey lungs
  - Municipal and agricultural lagoon wastes

R2 Program Provides

- Robust treatment
- Renewable energy production
- Tip fee generation which helps keep rates low
- In the future Program may also provide Renewable Energy Credits and Greenhouse Gas (GHG) Credits

Low Strength Waste (Headworks)

Acceptance of Liquid Wastes

EBMUD

Low Strength Waste Deliveries

~350,000 gpd

FOG / Biodiesel

Trap Grease to Biodiesel Pilot

FOG Experience

- FOG can cause blockages and SSOs
- EBMUD began accepting FOG ~10 years ago, in support of a regional control program
- Process and operations problems encountered during early years:
  - 3-foot scum blanket build up in primary digesters
  - “Blinding-up” on-line instrumentation
  - Impacts on whole effluent toxicity testing
- Partnership with third party to “harvest” brown grease led to a pilot to convert brown grease to biodiesel
- Currently, EBMUD accepts FOG directly to our upgraded thermophilic well-mixed digesters

Trap Grease to Biodiesel Pilot

Constructed a 100-gallon batch facility

Produced 1,300 gallons of biodiesel

Biodiesel Pilot Results

- QUALITY: Biodiesel from brown grease can meet all ASTM quality requirements with the exception of ultra low sulfur
- VEHICLE COMPATIBILITY: No short term vehicle maintenance or performance issues
- SIMILAR TO COMMERCIAL: Feasible to use brown grease biodiesel or commercial biodiesel
- TRUST: Our drivers and mechanics gained some confidence in the fuel
- VALUABLE BYPRODUCT: Glycerin may be digested to produce more biogas

Full Scale Biodiesel

- Production costs could be competitive with petroleum diesel, if significant amount of interceptor grease is available
- Cost strongly influenced by economies of scale and method to identify and procure interceptor grease from wide area (and perhaps supplemental virgin oil)
- Technical hurdles remain including:
  - Need for reliable cost effective means to convert interceptor waste (mostly water, some solids, about 2% grease) to brown grease (a feedstock for biodiesel)
  - Need for reliable cost effective means to reduce sulfur content to meet new California standards for Ultra Low Sulfur Diesel (15ppm)

EBMUD Future for Biodiesel

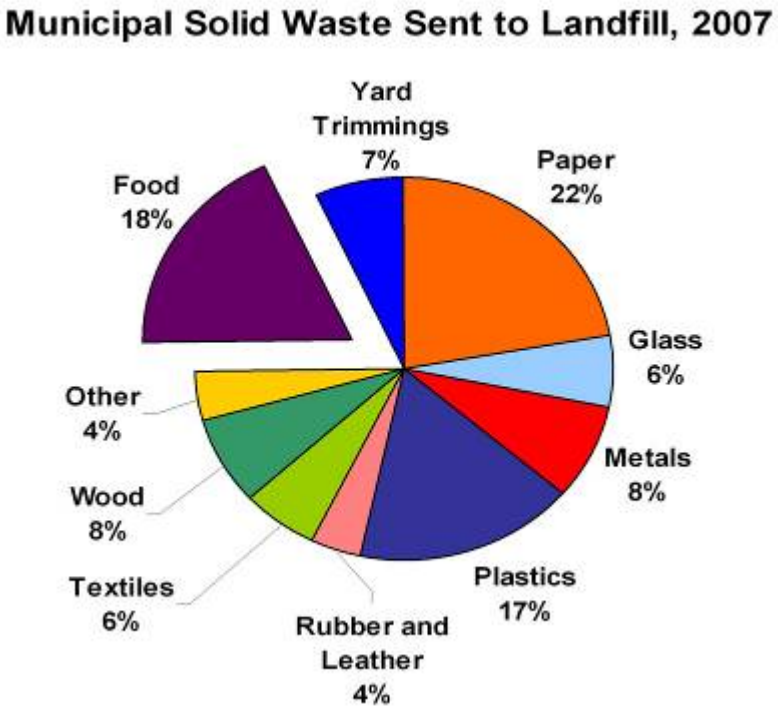
- Received $1M Grant from California Energy Commission to further research
  - Cost-effective brown grease production
  - Sulfur removal
- Securing land lease for glycerin waste
- Glycerin
  - COD > 10x municipal sludge (700,000 ~ 1,000,000 mg/L)
  - Negligible solids for disposal

FOG Receiving and Digester Blending

Food Waste

Food Waste

- Second largest category of municipal solid waste to landfills
  - Less than 3% currently diverted, mainly for composting
- Diversion from landfill conserves space and reduces GHG emissions



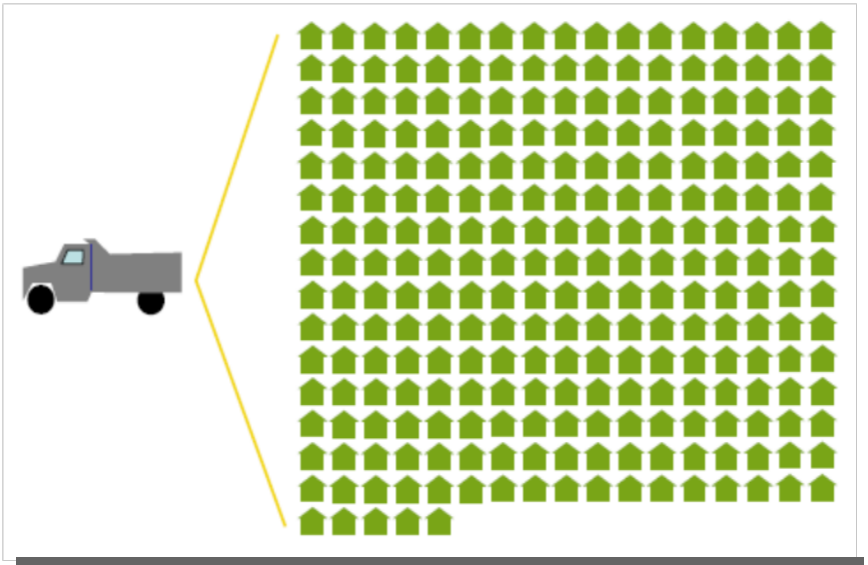
  - Organic material, like food waste, breaks down in a landfill and releases methane gas, which is a potent GHG

Food Waste Background

- Food waste is the largest single category of municipal solid waste in CA (16%) or 5.6 million tons (CIWMB, 1999)
- Key component for meeting mandated solid waste diversion goals (state law, AB 939)
- Composting is the most common diversion method
- Composting limitations:
  - Net energy consumer, long process (90 days)
  - Air quality concerns (VOCs)
- Anaerobic digestion has been successfully used to treat municipal sludge, but has not been widely used in the US for food waste.

Focus on Food Waste

- Food Waste creates 3.5 times the amount of energy as the same volume of municipal sludge
- Local sustainable feedstock for excess digester capacity
- Local solution to a local disposal problem benefiting the ratepayer and community



1 truck/day will power 260 homes (~0.2MW)

Food Waste Source

Food waste comes from Bay Area communities and commercial facilities

Contaminants in Commercial Food Waste

Off-site Removal of Large Contaminants

Local waste management company hauls and preprocesses food waste before it is anaerobically digested at EBMUD

Solid Liquid Waste Receiving Station

Food Waste Delivery at MWWTP

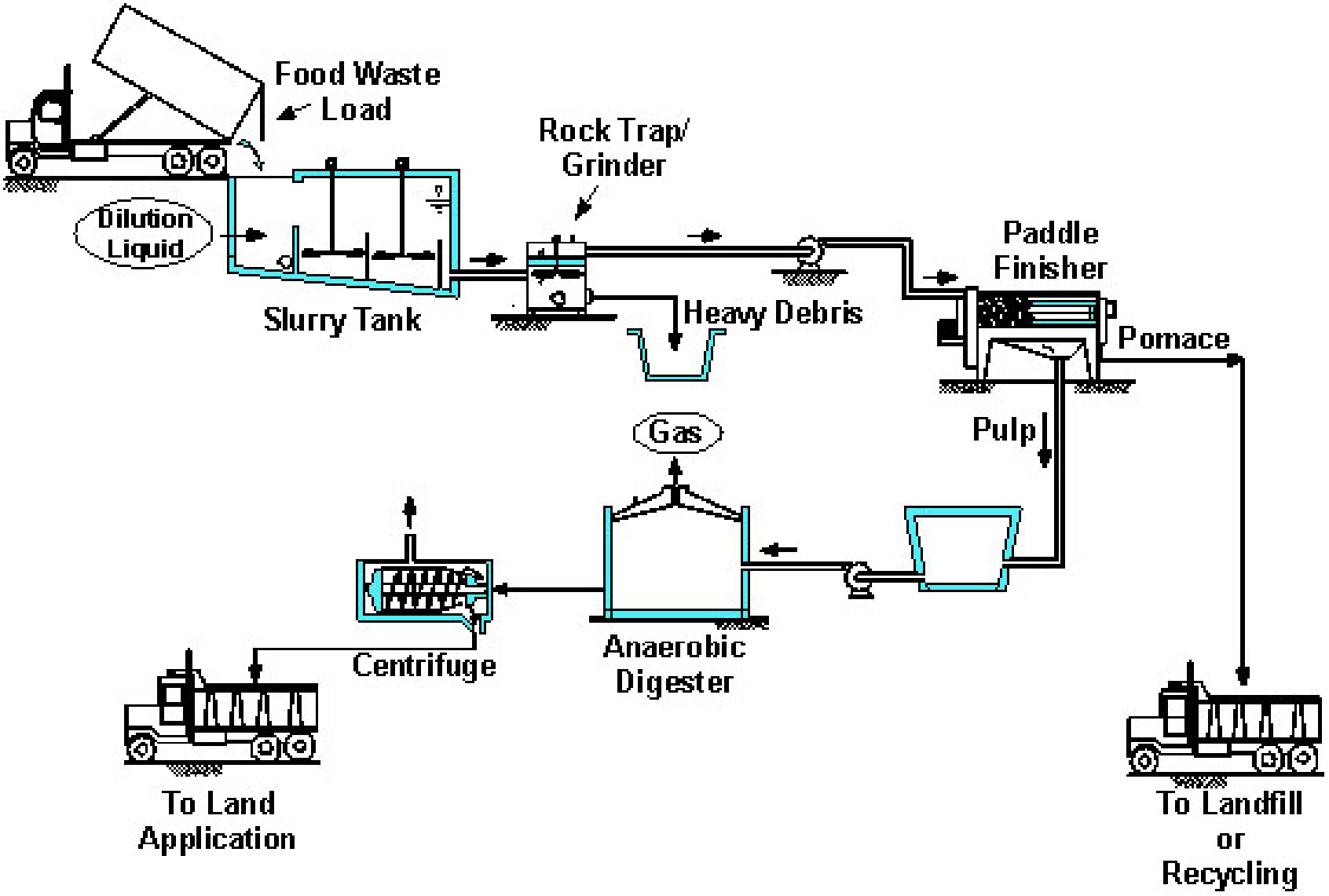
Food Waste Delivery

Contaminants in Delivered "Clean" Food Waste

Food Waste Contaminants

- Food waste contaminants led to processing problems - plugging, equipment damage.
- Contaminants included:
  - Silverware, chopsticks, shells, bottle caps, plastics.
- EBMUD staff investigated processes to remove contaminants.

Patented Food Waste Process



Food Waste Processing

EBMUD's Food Waste Processing System

Processing Residuals for Compost

Food Waste Challenges

- Non-traditional; no existing model (in US) for food waste processing and digestion at a wastewater treatment plant
- Significant effort in innovation and development of technology and process
- Creation of new relationships with food waste providers (solid waste haulers, solid waste authorities)
- Food Waste processing challenges
  - Understanding contaminant impacts to other treatment processes and equipment
  - Developing cost-effective contaminant control options; at source (restaurants), with preprocessing, and/or post-digestion?

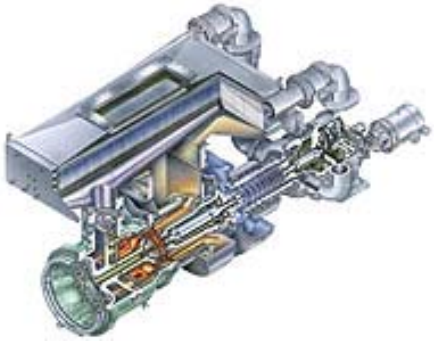
R2 Program Results

PGS Renewable Energy Expansion Project

- Installing a new 4.5 megawatt (MW) turbine to expand the existing Power Generation Station (online by July 2011)

Current
Three 2.1 MW Engines

Future
Add 4.5 MW Turbine

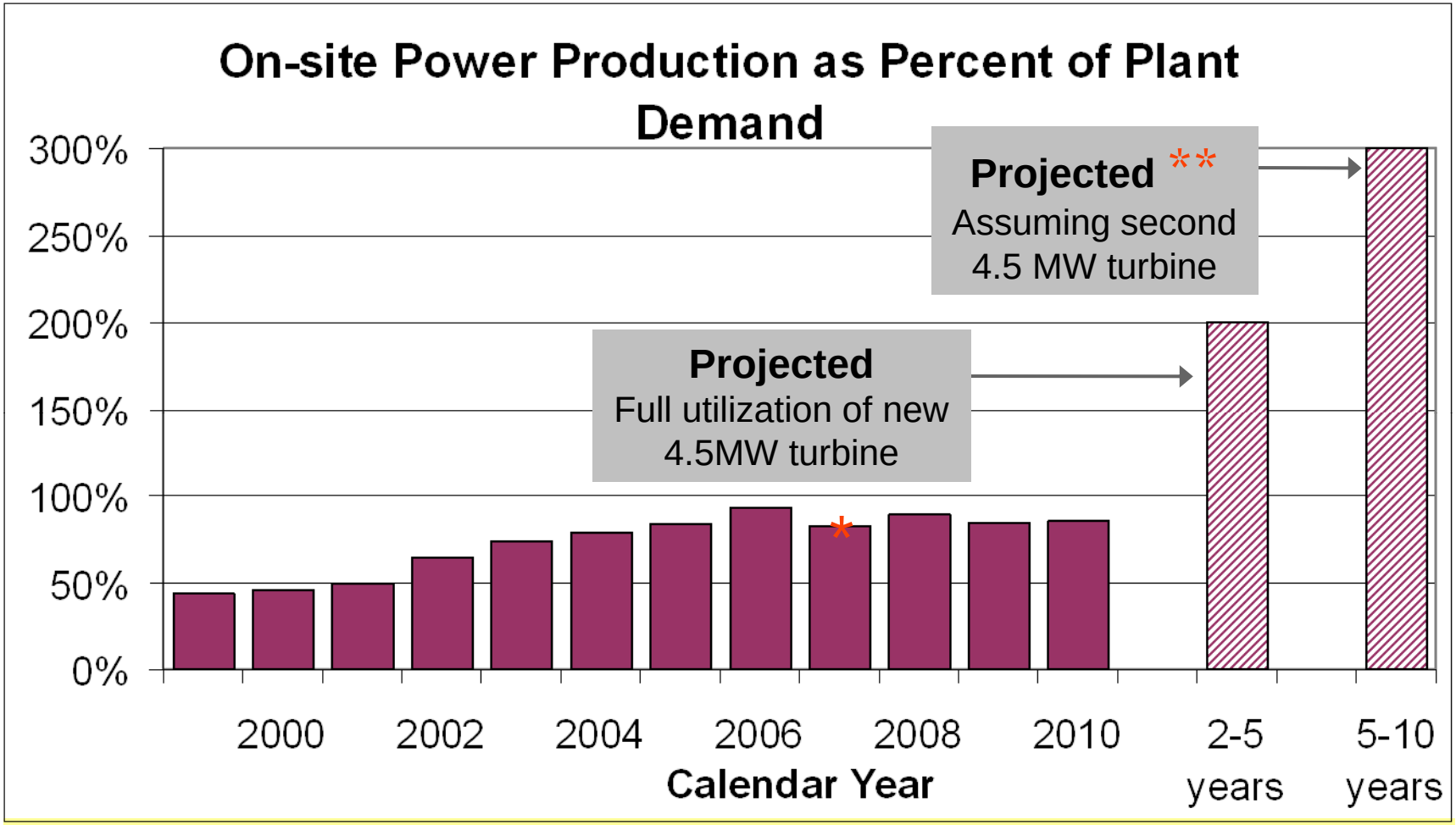


= 11 MW

- Become a net energy producer and reduce greenhouse gas emissions

Biogas Turbine

Renewable Energy Production



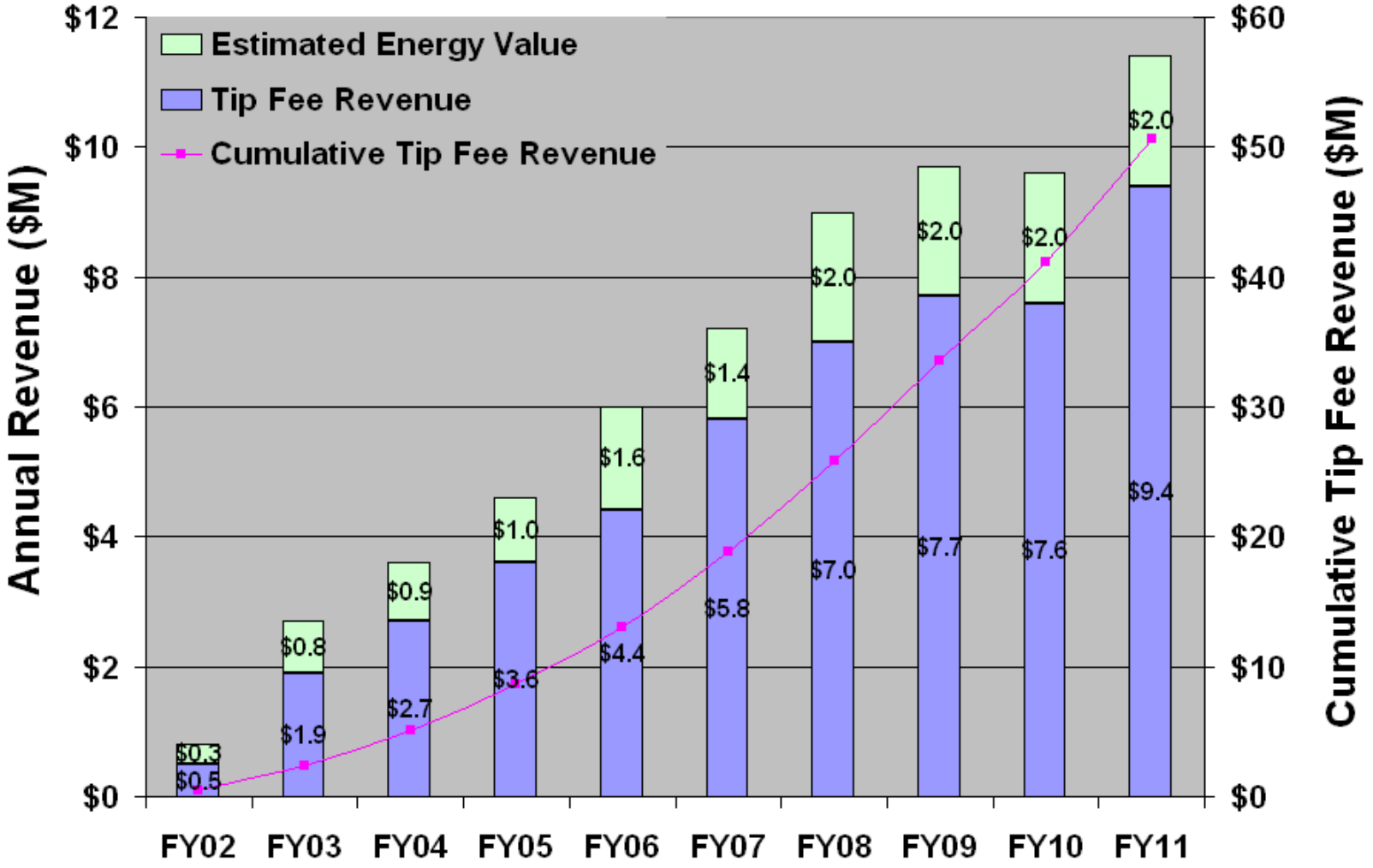
* *Slight drop in 2007 due to digester upgrade and engine overhaul projects*

** *Out year projection assumes availability of acceptable waste streams*

Current R2 Rates

Material Type	Rate ($/gal)
Septage	$0.07
FOG	$0.11 (non-conc) / $0.15 (conc)
Groundwater	$0.02
Process Water	$0.04
Gray Water	$0.03 (<75k mg/L TDS) $0.06 (75k to 200k mg/L TDS)
Sludge	$0.05 (up to 3% TS) + $0.01 per % TS up to 20%
Liquid Organic Material	$0.03
Solid Organic Material	$30 to $65/**ton**

Tip Fee and Energy Revenue



Trucked Waste Acceptance Challenges

- Rigorous acceptance criteria to ensure process integrity
- On-going research and pilot digester studies for evaluation
- Impacts to other treatment processes and equipment from sidestreams
- New system developed for tracking deliveries and invoicing

R2 Program Lessons Learned

- Anaerobic Digestion
  - Robust way to convert a range of organics to methane gas/energy
  - "Good mix" of waste streams needed to maintain digester health
  - Demonstrated operation outside published parameters with careful monitoring
- Regulatory Framework
  - May be entering solid waste permitting arena
  - Exploring merits of a rendering license
- Think Like a Business
  - Balancing traditional O&M perspectives with market-based considerations
    - 24-7 deliveries
    - Can you afford plant shutdowns and turning away trucks that depend on you?
    - Staff buy-in for cost-benefit of plant impacts with revenue and energy production?
  - Revenue stream is not "locked down" to one site; e.g., FOG volumes and tipping fees can plummet as more POTWs begin to accept this material
- Public Perception
  - High level of interest
  - Understand need to look for opportunities for renewable fuels/energy
  - Managing related odors is a key to long-term success

New Revenue Opportunities

EBMUD

Renewable Energy Credits and Offsets

Renewable Energy Credits (REC)

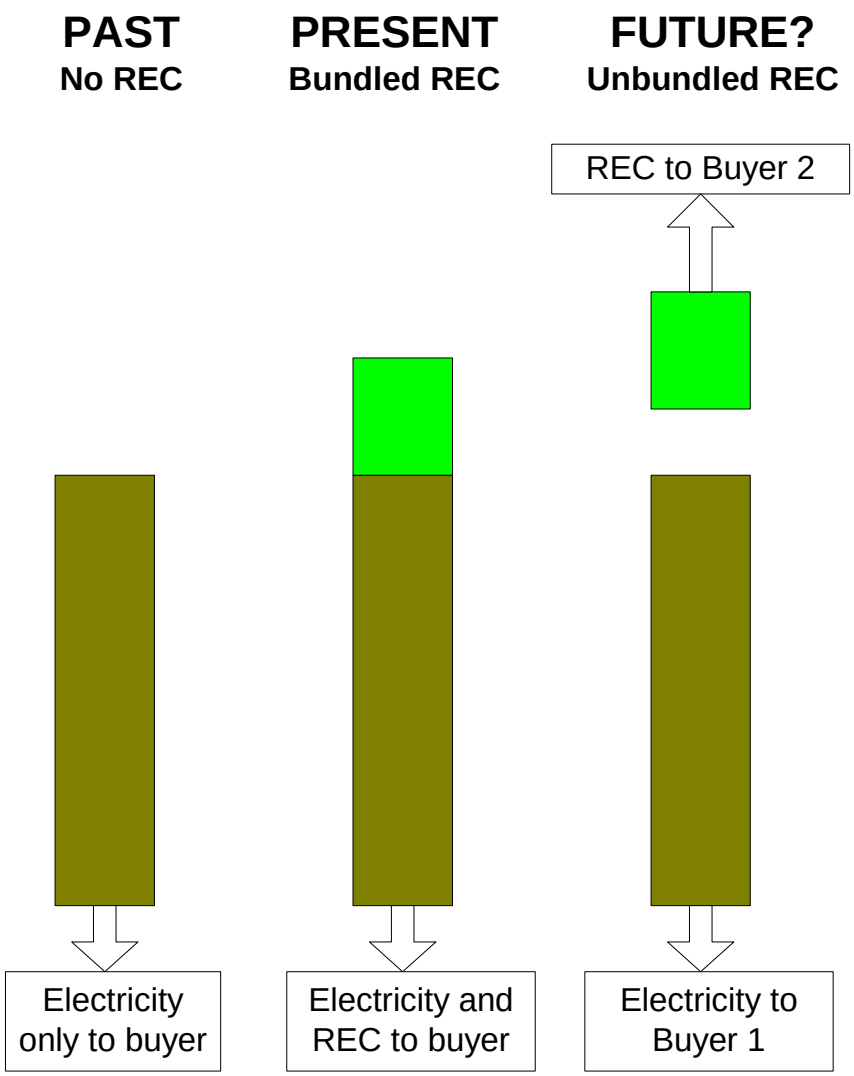
- A REC is the environmental attribute associated with the renewable energy
- Aka “green tag”
- Typically sold in units of MWh
- Unbundled from the electricity it could be sold separately

Renewable Portfolio Standard

- California's RPS is 20% by 2010 for investor-owned utilities (IOUs)
- IOUs might meet the RPS by purchasing RECs

"20% by 2010!"

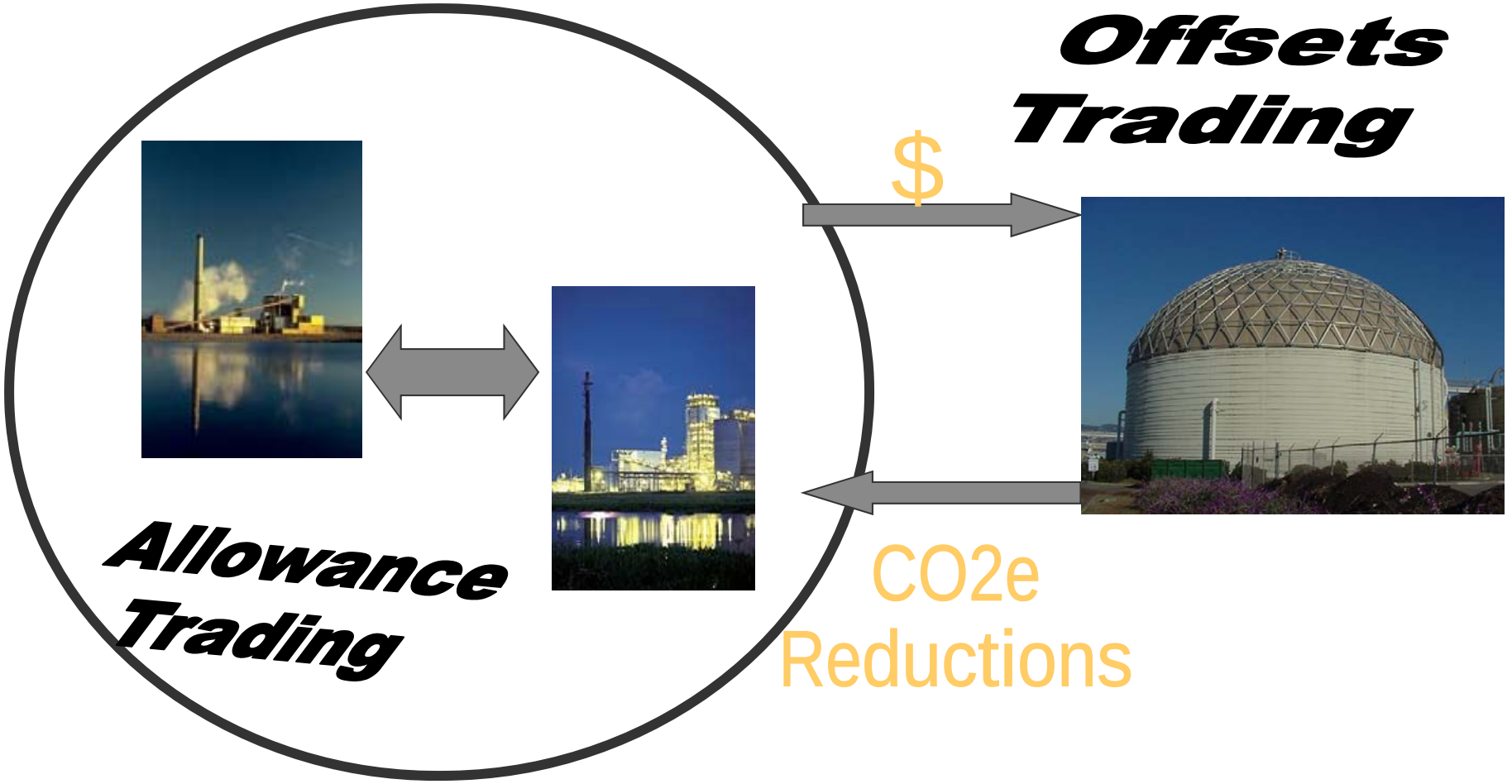
Expected Evolution of REC Sales in California



Greenhouse Gas Markets

- AB 32 requires GHG emission reductions to 1990 baseline levels by 2020 (~25%)
- California Air Resources Board (CARB) recommends cap and trade approach to reducing emissions
- Greenhouse gas (GHG) offsets are a potential component of cap and trade system

Emissions Trading: Allowances vs. Offsets



Revenue Opportunities?

- For WWTPs with renewable generation:
  - Green premium for power or REC sale
  - Possible GHG offset revenue for waste diversions, e.g., food wastes diverted from landfills

Looking to the Future

Food Waste Sourcing

- Interest in securing long term commitments with local food waste providers
- Signed a contract with Central Contra Costa Solid Waste Authority
  - 5.5-year contract for up to 15 tons per day (tpd)
  - Tip fee starting at $45/ton and escalating annually
  - Sharing of any REC or GHG credits TBD
- Signed contract with Recology
  - 10 to 20 year contract for 120 tpd
  - Tip fee starting at ~$46 and escalating annually
  - Sharing of energy value and REC
- Land-lease to Recology for construction of a Food Waste Receiving and Preprocessing Facility

New R2 Wastes

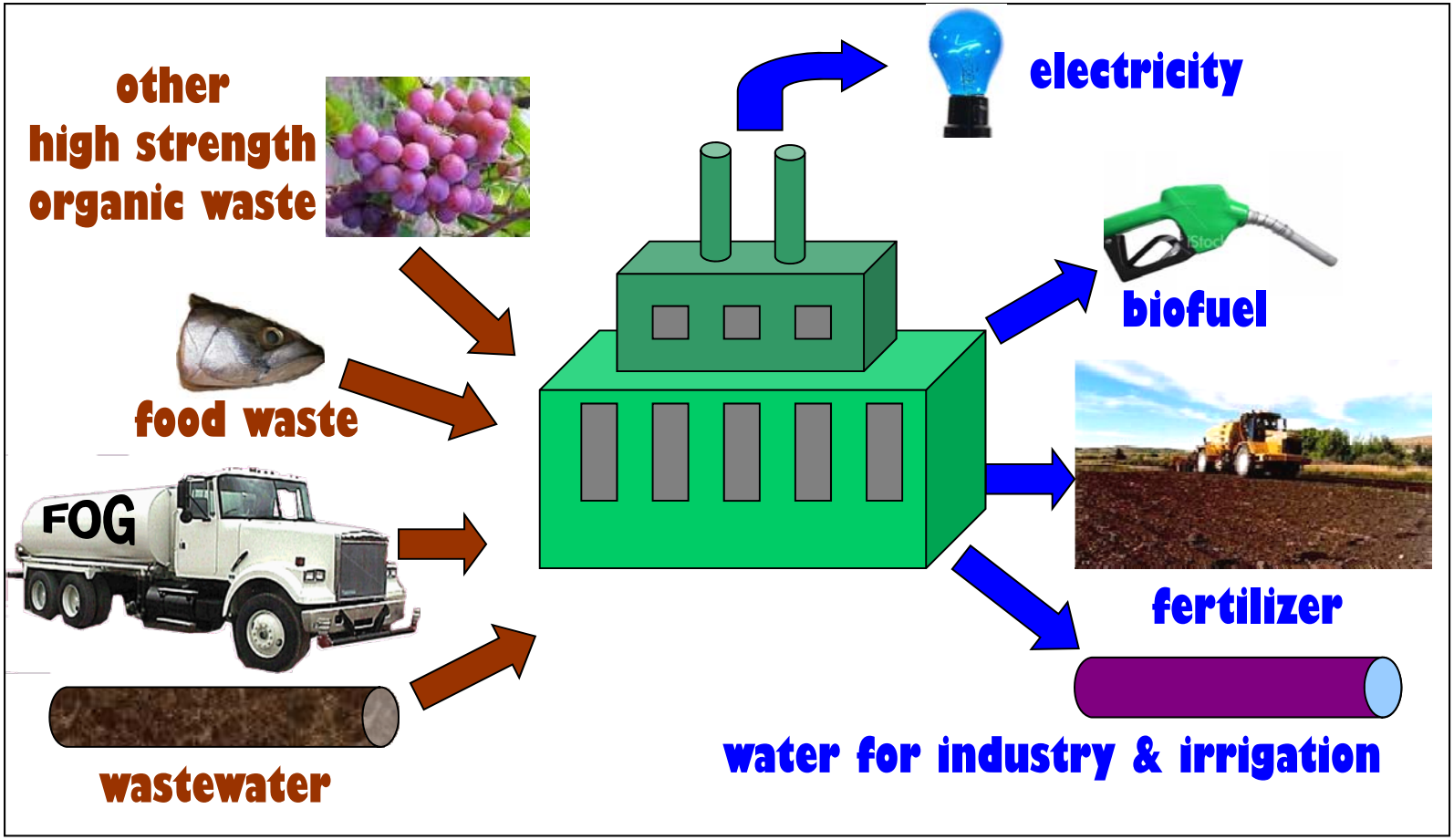
- Competition for organic waste from other POTWs continues to grow so focus for growth is on wastes that are more complicated from a technical or regulatory perspective, e.g.:
  - Residential Food Waste
  - Green Waste
  - Biofuel By-products
  - Field Dead and other Animal Processing By-products

THE WWTP AS A "GREEN FACTORY"

A New Role for WWTPs?

- Historically: A protector
- New Role: A provider
- Forces driving new role:
  - Natural resource scarcity
  - Climate change
- Producing green products can help to reduce WWTP's carbon footprint

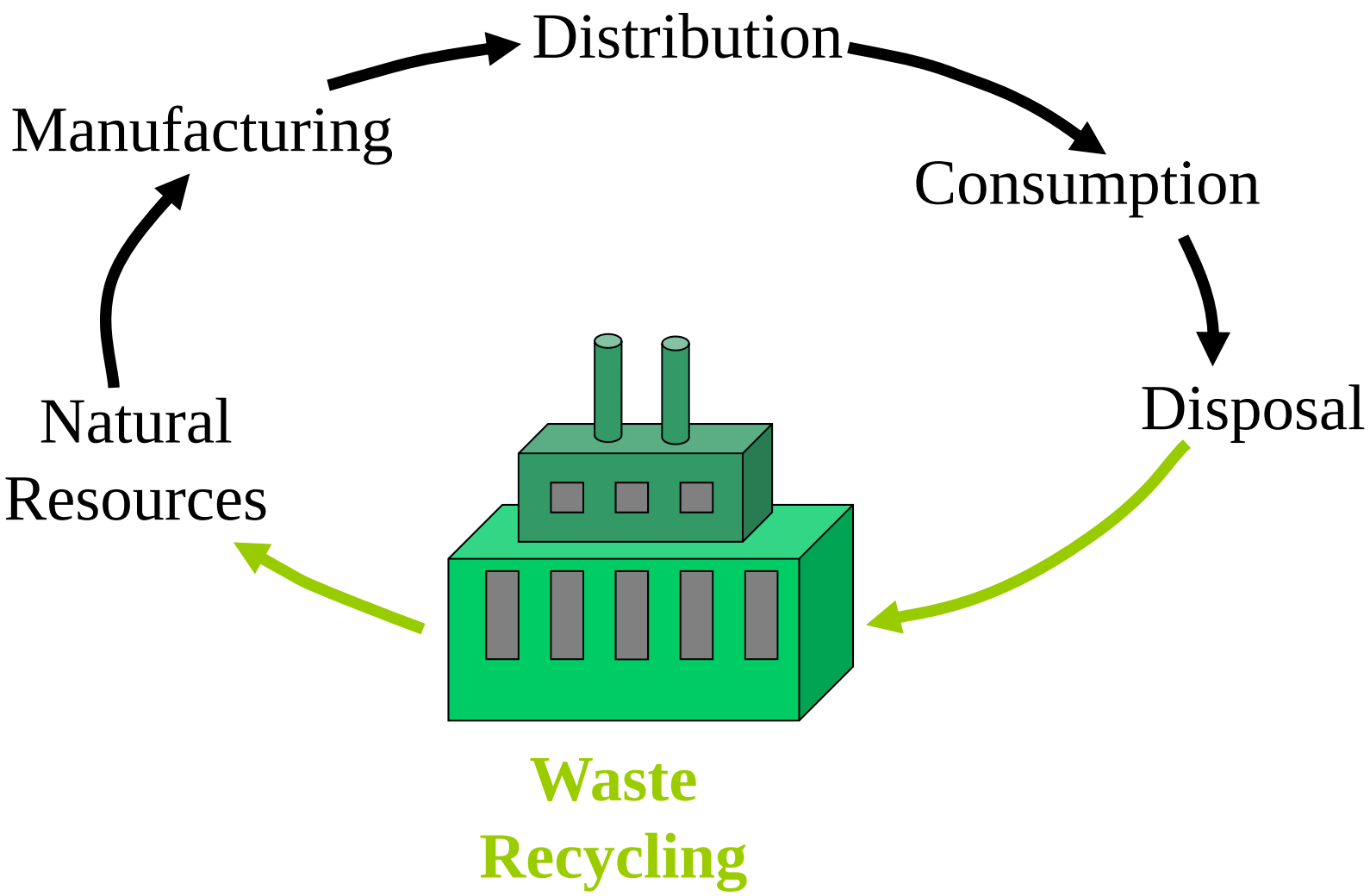
Possible Green Products



Challenges and Opportunities

Challenges	Opportunities
Waste to Energy R&D investments	Greater energy self-sufficiency and associated cost savings
Impacts to existing treatment processes	New revenue streams from environmental commodities
Capital req'ts for new facilities	Reduced carbon footprint
Mgmt of energy purchases and sales	Potential to pass on savings to ratepayers
GHG emissions compliance	Value of offsets and REC's from renewable energy

Closing the Materials Cycle Loop



? Questions