Environmental and business perspective: Anaerobic digestion biogas-to-energy

Presentation at
Stonehill College
Environmental Science
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CommonWealth
Resource Management Corporation

- Founded in 1991
- Management consulting: 27 years in solid waste and renewable energy industries serving private and public sector clients
- Project development, ownership and operation:
  - Co-developed 7 landfill gas-to-energy facilities (LFGTE)
  - Developed, owned and operated 3 LFG utilization facilities
  - Currently own and operate 1 LFGTE facility and 1 AD facility
  - First AD facility in New England integrated with LFGTE facility and landfill

CRMC LFGTE and AD Biogas Project

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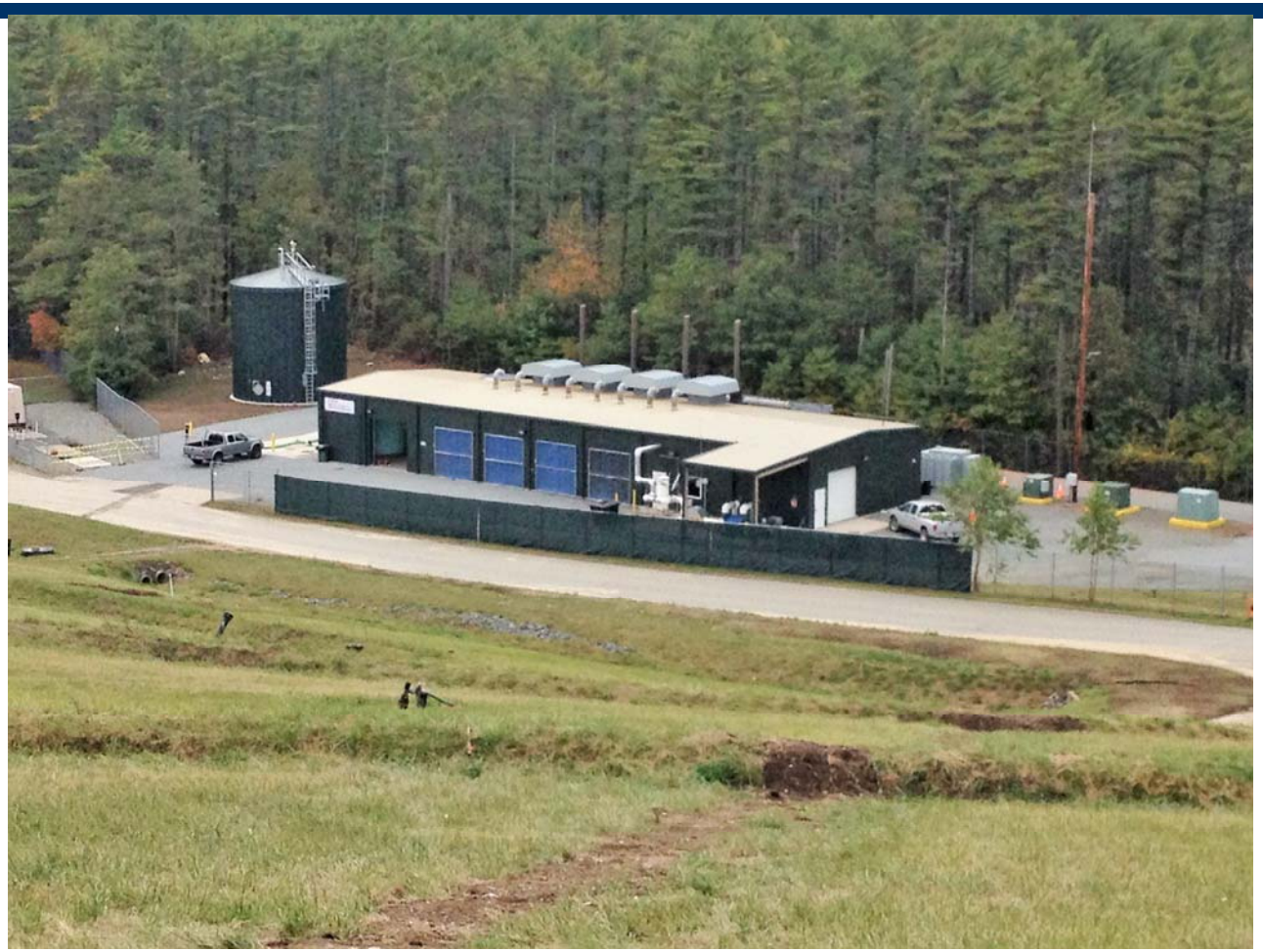


Today's Solid Waste Market Development

- Highly regulated market
- Drivers of the business
  - Reality of managing waste/materials every day
  - Regulatory framework and requirements
    - Divert from disposal
    - Strict environmental protections on disposal
  - Economics
    - Profit consistent with returns on investment
    - Extract value from waste economically
    - "Highest and Best Use"
    - Renewables still need financial assistance – tax credits, renewable energy credits, carbon credits, grants, RINs, etc.

How did we get where we are today? Brief Massachusetts History

- Massachusetts comprised of 351 municipalities
- 1950s and 60s waste management
  - Small town open burning dumps
  - Small incinerators and dumps in Cities
    - Sited in swamps on municipal borders
    - Household self delivery
    - Small local haulers
    - Garbage (food waste) source separated for animal feed

Milford MA Town Dump
Cedar Swamp Pond (Charles River) 1968

Regulations Arrive

- USEPA formed December 1970
- Clean Air Act of 1970
  - Comprehensive fed and state regulations to limit emissions from sources
- Resource Recovery Act 1970
  - Ban open dumps
  - Gov't regulates waste management
  - New view -- recycling and renewable energy

1970s

- Clean up the air
  - No more open burning at dumps
  - Start of shut-down of dumps and incinerators
- Town dumps in transition
  - Still mostly unlined
  - Solid waste covered with dirt daily
  - New environmental impacts
    - Leachate (waste water) leaching into ground water
    - Anaerobic digestion of waste generates Landfill gas

1980s

- MA DEP initiatives to close unlined landfills
  - 203 open landfills (mostly unlined)
- Regional large scale disposal facilities developed
  - Modern large-scale lined landfills
  - Waste-to-energy facilities 7 facilities, 3.0 million TPY, 1.6 million MWh electricity ~230,000 Massachusetts homes
- Recycling Initiatives
  - Bottle Bill 1983
  - MA Solid Waste Management Act of 1987
    - Establish Hierarchy Reduce, Recycle, Recover energy, Landfill
    - Waste bans on items for disposal

Landfilling of waste transition

Town dump

1968 Milford, MA

Regional modern landfill

2018 Dartmouth, MA

Fate of landfills in Massachusetts

Year	Landfills
1980	203
1990	<100
2000	<50
2010	16
2018	7
2020	5
2030	2
2040	0

Combustion of waste transition

Incinerator 1950s

Waste-to-energy 1980s

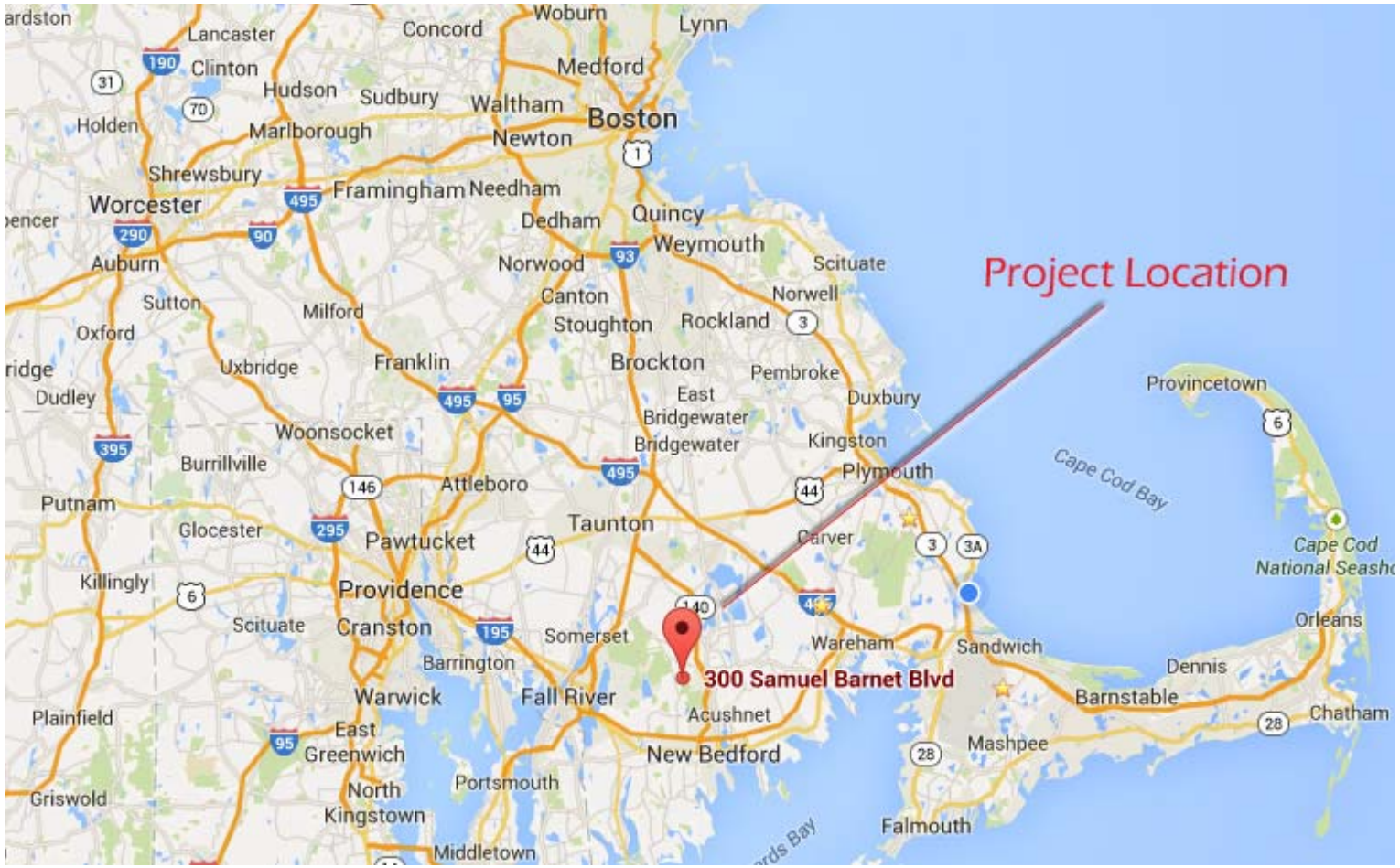
1990s

- WTE – State moratorium on new projects
- Recycling household curbside programs developed
- Landfills (now fewer than 100 open)
  - Continued closure & capping of unlined landfills
  - Modern large-scale lined landfills generating LFG
  - LFG odors, safety, and explosions
- Mitigate LFG issue
  - Collection and Control systems
  - LFG-to-energy development
    - Tax credits, high electricity costs,
    - MA Renewable Portfolio Standard (2002),
    - Carbon credits

LFG-to-energy Facilities in MA

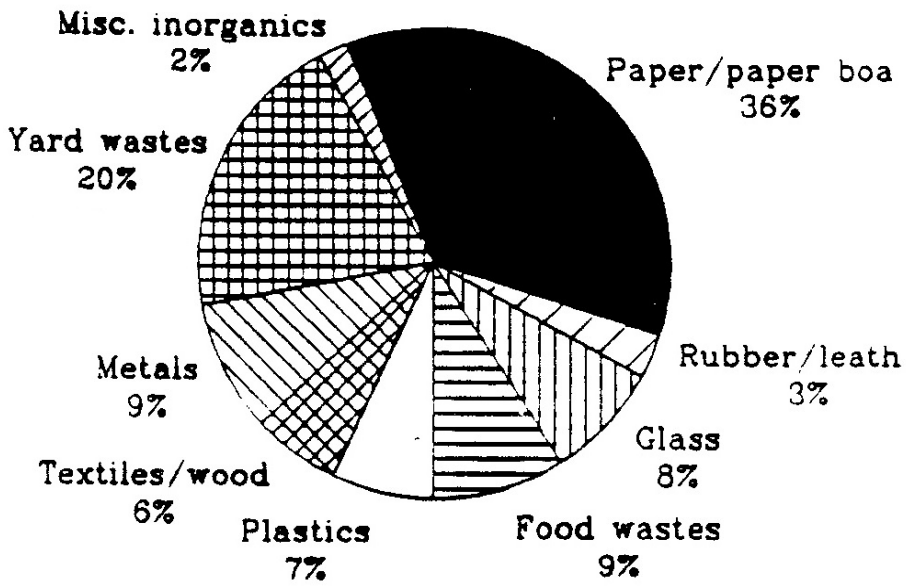
- 22 LFGTE Projects installed since 1995
  - 14 permanently shut-down
  - 9 remain open in 2018
    - 4 at Closed Landfills
    - 3 at Landfills scheduled to close within 2 years
    - 2 at Landfills open longer term
- 63 MW of LFGTE Capacity installed since 1995
  - 21 MW permanently shut-down (32%)
  - 42 MW capacity remain in 2018 (68%)
    - 28 MW of remaining 44 MW capacity used (54%)
    - *16 MW of capacity unused – short supply of LFG*

Location:
CNBE LFGTE Facility and CRMC Bioenergy Facility

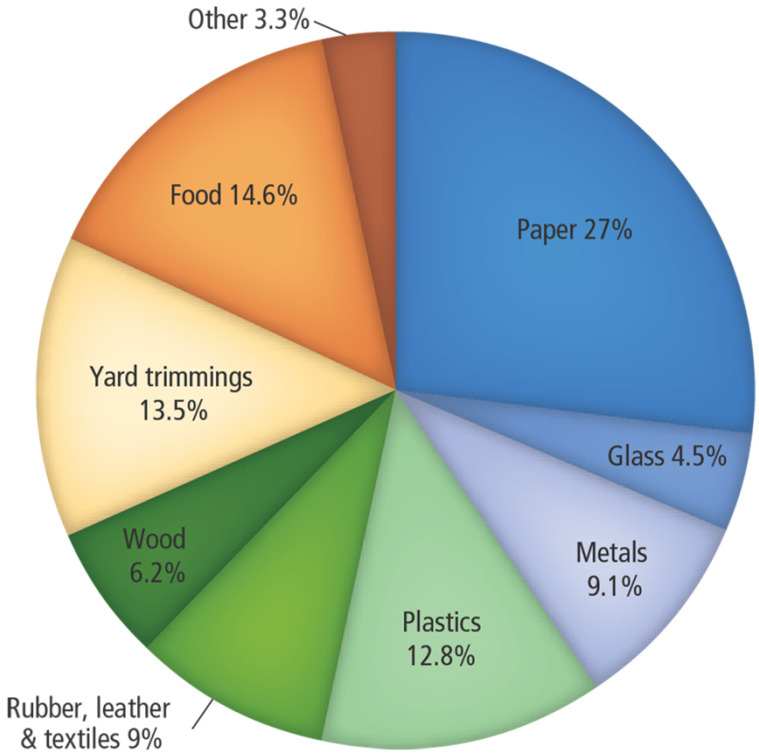


MSW before recycling: Beneficial use of food waste

MSW 1990

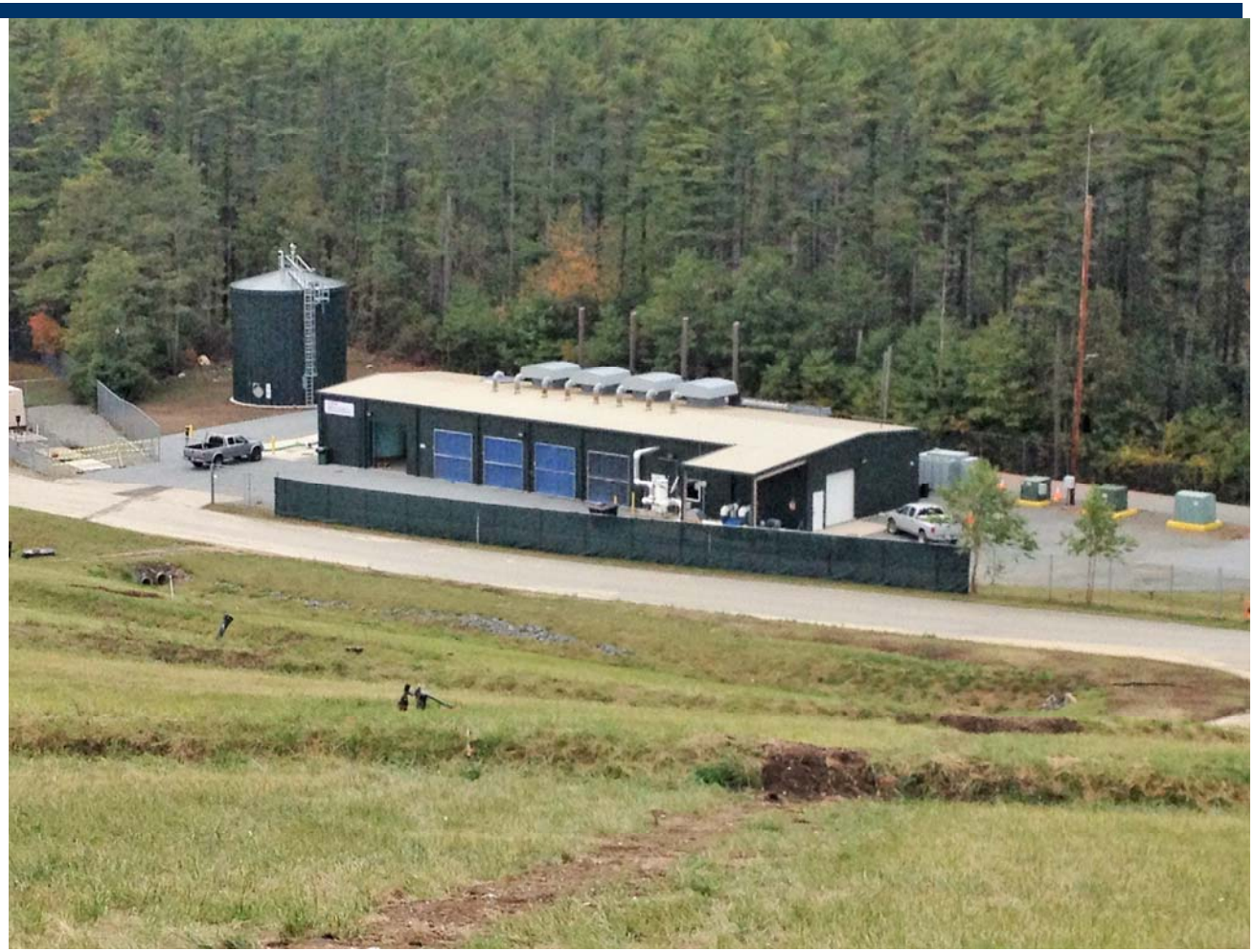


MSW today



Crapo Hill Landfill, Dartmouth, MA
152 Acre Site + 340 acres of buffer

CommonWealth New Bedford Energy LLC
3.3 MW LFG-to-Energy Project
Commence Operation 2005



4 Caterpillar Engine-Generators Combust LFG and biogas to make Electricity

AD biogas-to-energy projects: Supportive of development

- Environmentally Beneficial Project
- Consistent with public policy
  - Green Communities Act, the Green Jobs Act, Global Warming Solutions Act
  - MDEP's Solid Waste Master Plan (April 2013)
  - Stated goals for increasing levels of renewable energy production in Massachusetts.

AD biogas-to-energy projects: Supportive of development

- Consistent with Public Policy
  - Grants available through MassCEC and MDEP
  - Qualified to net meter power generated from biogas-to-energy
  - Qualified under Renewable Portfolio Standards Program
  - Permitting under Site Assignment and Solid Waste Regulations
  - Ban on disposal of food waste (October 2014)

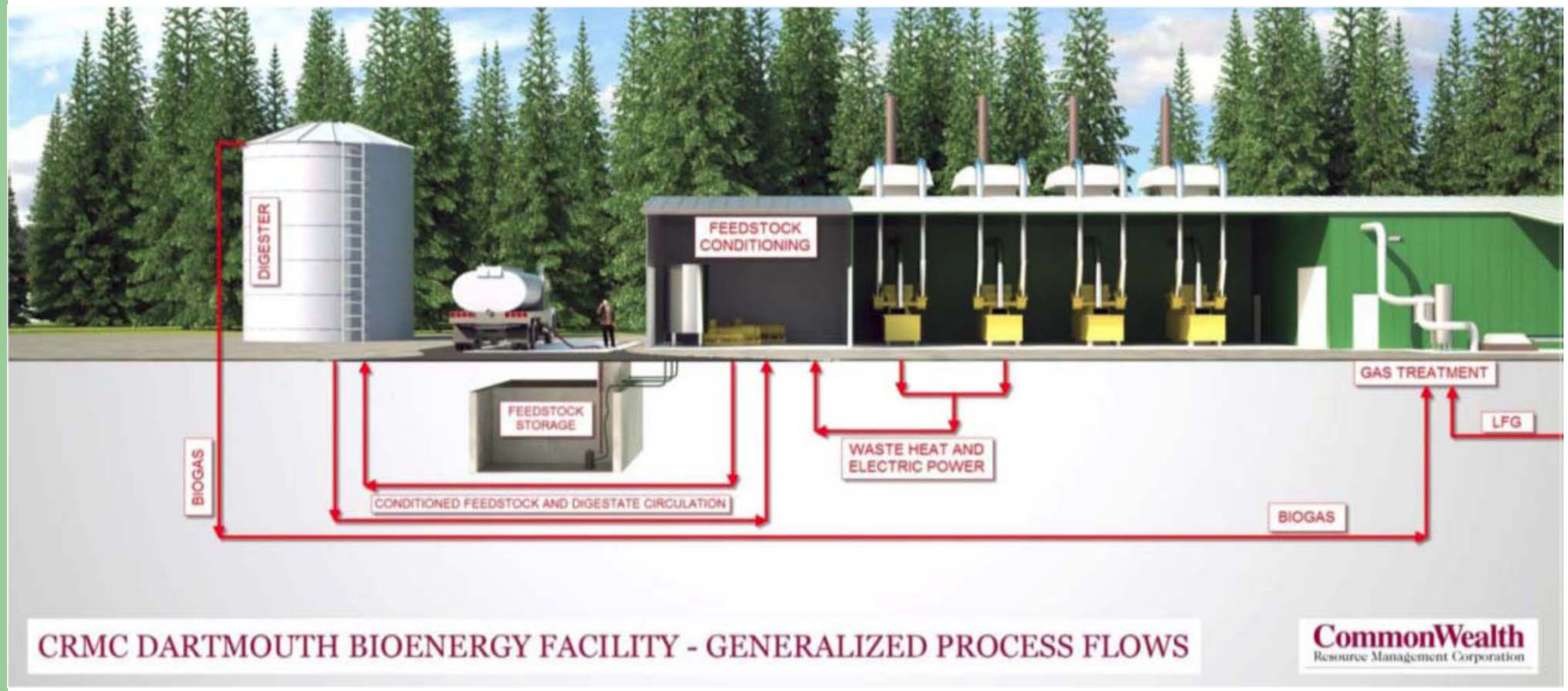
CRMC Bioenergy Facility: Project Components

- Initial phase (pilot): Operational since November 2014
  - Feedstock receipt and storage
    - 36,000 gallons intake capacity in three underground tanks
    - Pumpable form of Food Waste, WWTP sludge, FOG
  - Feedstock conditioning: Mix and heat feedstocks
  - Digestion
    - 100,000 gallon anaerobic digester
    - Continuous feed, wet, mesophilic anaerobic digestion
    - Continuous hydraulic mixing
    - 1+ million gallons per year
  - Products: biogas (~1 to 2 MMBtu/hr) and digestate
- Final commercial scale: Initial phase x 10
  - 1 million gallon anaerobic digester
  - Digestate processing
  - Products: biogas (~10 to 20 MMBtu/hr) and digestate

Integrated components

- Renewable energy power plant (3.3 MW)
  - Owned by CommonWealth New Bedford Energy LLC
  - Operational since 2005
  - Fueled by biogas from landfill and digester
  - Provides thermal energy, power, and odor control to CRMC Bioenergy facility
- Crapo Hill Landfill
  - Owned by Greater New Bedford Regional Refuse Management District
  - Active MSW landfill serving New Bedford and Dartmouth
  - Operational since 1995
  - Provides end-uses for digestate
    - Injection in closed, capped area to increase LFG production
    - Substitute for water in posi-shell, daily landfill cover
    - Additive in yard waste compost

Integrated system



CRMC Bioenergy Facility

Front View: CRMC Bioenergy Facility and CNBE LFGTE Facility

CRMC Bioenergy Facility

Side View of Digester, Receiving Area, Process Building

CRMC Bioenergy Facility

Back View of Digester, Receiving Area, Process Building and Landfill

CRMC Bioenergy Facility

Receipt of feedstock

CRMC Bioenergy Facility

Process room

Objectives of First Phase Operation

- Infrastructure for organic waste management to respond to regulations (2014 Massachusetts organic waste ban)
- Increase on-site power generation for LFGTE plant
  - Determine optimal balance of feedstocks
- Determine best management/end-uses of digestate
  - Enhance the production of landfill gas for the LFGTE plant.
  - Low nutrient liquid additive for existing leaf and yard waste compost operations
  - Additive to compost

Objectives of First Phase Operation

- Determine key performance metrics for design and performance of full commercial scale
- Determine incremental components required to build and operate at final commercial scale
  - Transform packaged food waste to food waste slurry
  - Transform digestate to usable and marketable form beyond landfill usage
- Aggregate pumpable SSO direct from sources and through liquid waste haulers

AD biogas-to-energy projects: Challenges to development

- Emerging market with many uncertainties
  - SSO supply agreements
  - Packaged solid food waste requires depackaging infrastructure
  - End-uses of Digestate
  - Power Purchase Agreements
  - Interconnection
  - Air permitting
- Ability to finance

Full Commercial Scale AD Biogas Project

Questions?