Prospects for Anaerobic Digestion in the U.S.

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GBB Quality – Value – Ethics – Results

- Established in 1980
- Solid Waste Management and Technology Consultants
- Helping Clients Turn Problems into Opportunities

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GBB's Waste Consulting Services

- Economic, technical and environmental reviews
- Procurements
- Due diligence third-party reviews
- Waste characterization and sourcing
- Process planning and conceptual designs
- Independent feasibility consultant

Outline

- Anaerobic Digestion in the U.S.
- Economics and Funding
- Trends & Drivers
- Prospects of AD in the U.S.

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ANAEROBIC DIGESTION (AD) IN THE U.S.

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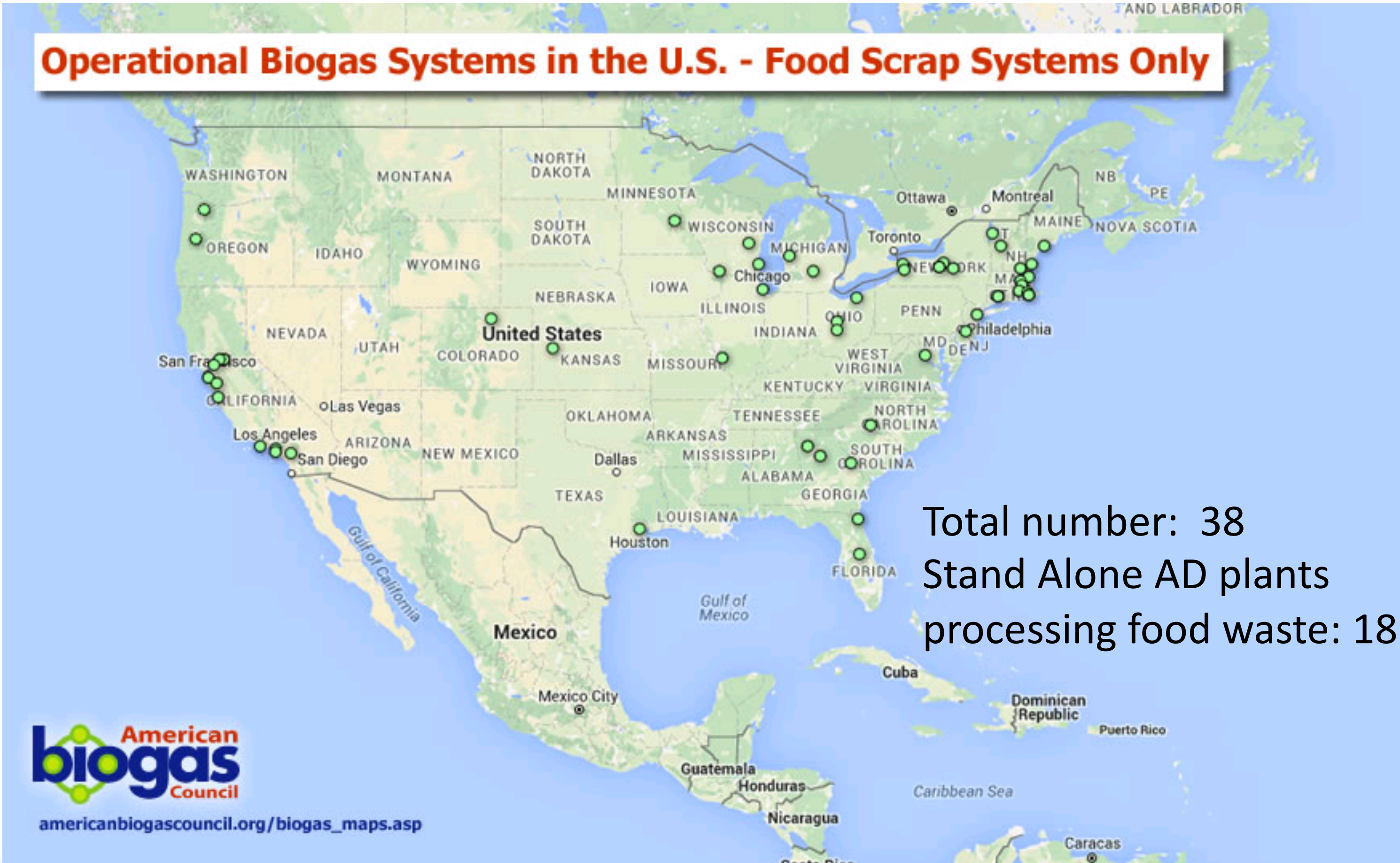

Total number: 38

Stand Alone AD plants processing food waste: 18

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Facilities and Market Leaders

- Privately financed, owned and operated
- Commercial food waste
- Organics from MSW
- Mixed with yard waste

- Established in 2006 in Cleveland, OH
- Initially European technology
- Integrated Anaerobic Digestion System (iADs)- patent pending technology developed at Ohio State University
- Over $150M in Executed Projects
  - 14 Operational Digesters (OH, NY, MA, ME)
  - Capacity to annually manage 700,000 tons of organic waste
- Municipal, Industrial & Agricultural Ads
- Mature US Supply Chain

Cleveland, Ohio

Wooster, OH

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ZeroWaste™ ENERGY, LLC. Recovery and Energy with Zero Waste

- US company based in Lafayette, CA
- Dry Anaerobic Digestion licensee for:
  - KompoFERM
  - SmartFERM
- Plants:
  - Monterey Regional Waste Management District, Marina, CA
  - Zero Waste Energy Development Co., San Jose, CA
  - Blue Line Transfer/SSF Scavengers, South San Francisco, CA
  - 3 plants under construction and development

South San Francisco, CA

San Jose, CA

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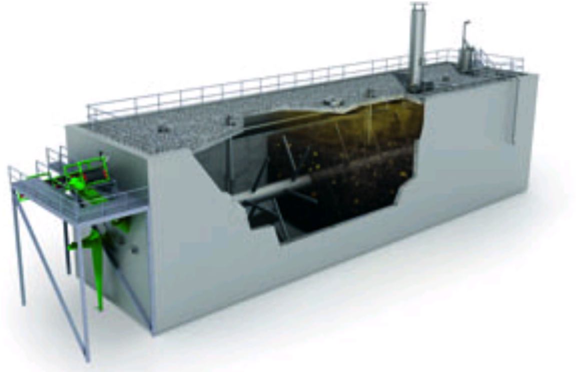
KOMPOGAS by Hitachi Zosen INOVA

- One of the world leaders in AD
- Dry anaerobic digestion
- 75 plants around the world
- Plant under construction in San Luis Obispo County, CA
- 400 years of accumulated operating experience

Doha, Quatar



Kompogas® Digester

Botarell, Spain

Projects Under Development & Construction

Total: 26
Under Development: 16
Under Construction 10

Yellow- Under development
Green- Under construction

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Prince William County, VA

- Through RFP procured a build, finance, own, operate contract with Freestate Farms
- 80,000 tpy of organics facility includes:
  - Wet Anaerobic digestion
  - Aerated composting of digestate and yard waste
  - On-site greenhouses for growing organic food
  - Sale of high grade compost
- Start construction fall 2016, operational 2018

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CR&R – Perris, CA

EISENMANN

- 500 tons per day of food and yard waste
- Expandable to 1,000 tpd
- Under construction, start up late 2016
- Methane to fuel waste collection trucks

Food Waste Management Regulations and Legislations

- State Level
  - California
  - Connecticut:
  - Massachusetts
  - Minnesota
  - Rhode Island:
  - Vermont

- Local Level
  - Austin, Texas
  - New York City, New York
  - San Francisco, California
  - Seattle, Washington
  - Washington, DC

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ECONOMICS AND FUNDING

System Economics

- Tipping fees at operating plants:
  - $40-$100/ton
  - Cleaner the feedstock lower the tipping fee
- Capital expenses
  - Different for different types of AD
  - $300-$500 per installed annual ton of capacity
- Operating Expenses
  - 2-3% of the Capital Expenses per ton processed

Revenue Sources

- Electricity/ biogas sale
- Digestate/ fertilizer sale
- RINs
  - $0.90-$1.80/"gallon" (77,000 BTUs) for biogas>vehicle fuel
  - Types for biogas: D3 cellulosic advanced and D5 advanced
- Low Carbon Fuel Standard (LCFS), CA
  - Metric Tons of Carbon Dioxide equivalent (MTCO2e) avoided
  - $85-$100 per credit
- RECs (eligibility depends of the state)
  - $20/MWh – PJM value
- Production Tax Credit-
  - Section 45: Open/closed-loop Biomass (electricity)
    - 1.15 cents/kWh (x2 for closed loop)

Capital Funding

- Investment Tax Credit-
  - Section 45: Open/closed-loop Biomass (electricity)
    - 30% of qualifying property (capital costs)
  - H.R.5489 — Agriculture Environmental Stewardship Act of 2016 (non-electricity)
    - 30% ITC
  - Loan Guaranteed
  - Private investment sources

TRENDS & DRIVERS

Trends

- Growing interest in managing organic waste separately
- Higher recycling and diversion goals
- From private initiatives only to the public sector
- More world leading technology developers/ vendors
- Legislative support
- Financial support
- Co-digestion at wastewater treatment plants

AD Project Drivers

- Tipping Fees
- Landfill Capacity
- Waste Stream
  - Quality and Quantity
  - Collection Method
- Marketability of Commodities
  - Biogas Use
  - Compost market
  - Fuel replacement economics
- Regulations
- Community and Political Influences
- Competitive Landscape

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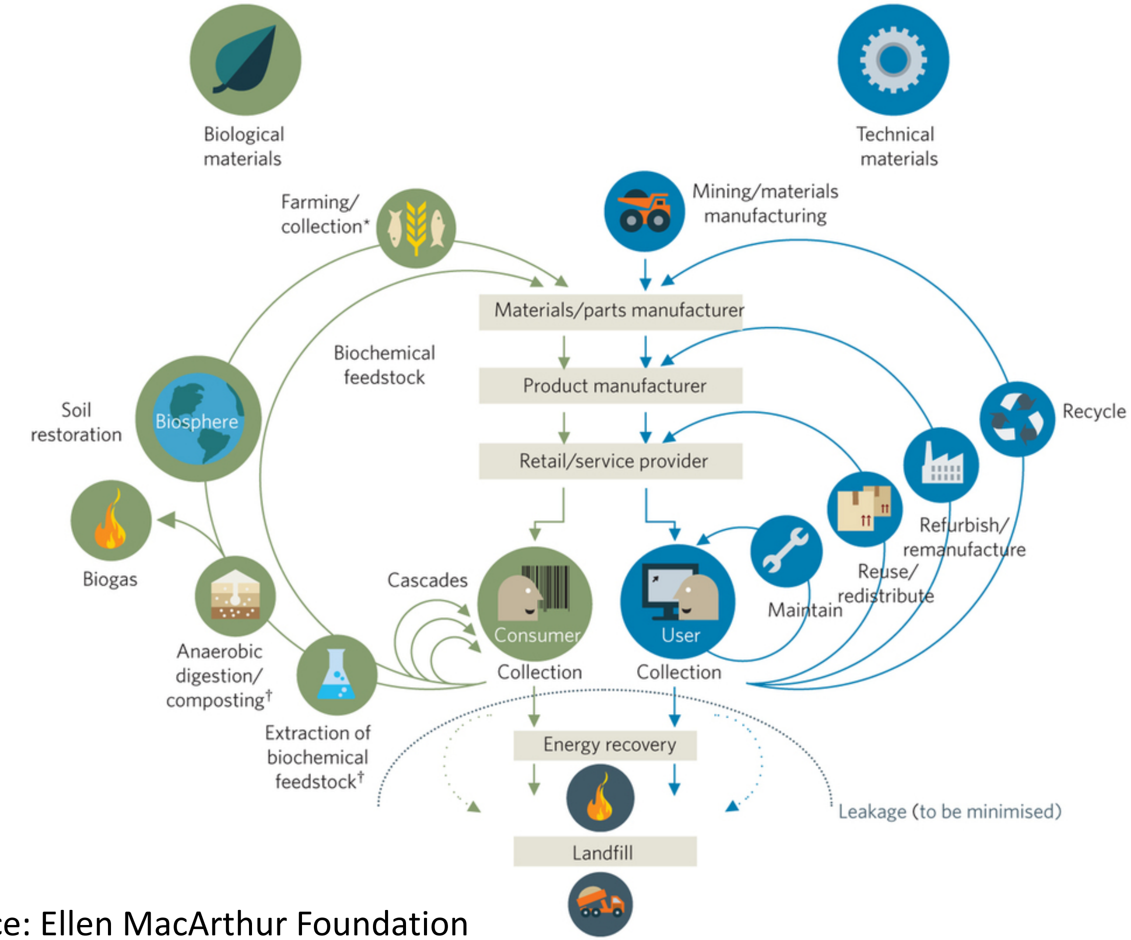
Circular Economy



Source: Ellen MacArthur Foundation

PROSPECTS OF AD IN THE U.S.

Significant Attention

- Biogas Opportunities Roadmap
  - By USDA, US-EPA, USDE- August 2014
  - Part of the White House Climate Action Plan- Strategy to Reduce Methane Emissions
- U.S. EPA Sustainable Materials Management Program Strategic Plan (2017-2022)
  - Develop infrastructure (composting and AD plants)
  - Promote opportunities across the entire food life cycle to reduce wasted food from landfills
  - Improve and standardize measurement of wasted food
- ReFED- Rethink Food Waste
  - A Roadmap to reduce U.S. food waste by 20%
  - Assessed Technical and Economic Impact of 27 Solutions

Significant Funding Opportunities

amazon

Stern Brothers & Co.
INVESTMENT BANKING SINCE 1917

Google green

Microsoft

STIFEL

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Opinion of Future Trends

- Stand alone AD facilities
- AD facilities as part of Mechanical Biological Treatment Facilities or together with composting, MRF’s or WTE facilities
- As projects like Prince William County become reality the public sector will feel more comfortable and willing to accept more risk
- More experienced AD project developers

In Summary

- Bright future for the AD in the U.S:
  - AD technology is proven (moderate to low risk)
  - Vendors are known and experienced
  - Existing legislative support
  - Funding Sources available
- Business case is the key
- It is a game changer without significant system changes and fees increase

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Optional half-day pre-conference workshop

"From Concept to Reality - Waste Conversion Project Implementation"

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Questions and comments?

Thank you!

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