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Challenges with Anaerobic Digestion

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Challenges with Anaerobic Digestion

- Anaerobic Digestion Basics
- Waste Management and Energy Creation Across Sectors
- Anaerobic Digestion Feedstock
- Buying a Biogas plant
- Running a successful Biogas Plant

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Anaerobic Digestion Basics

Technological Fit with Food Recovery?

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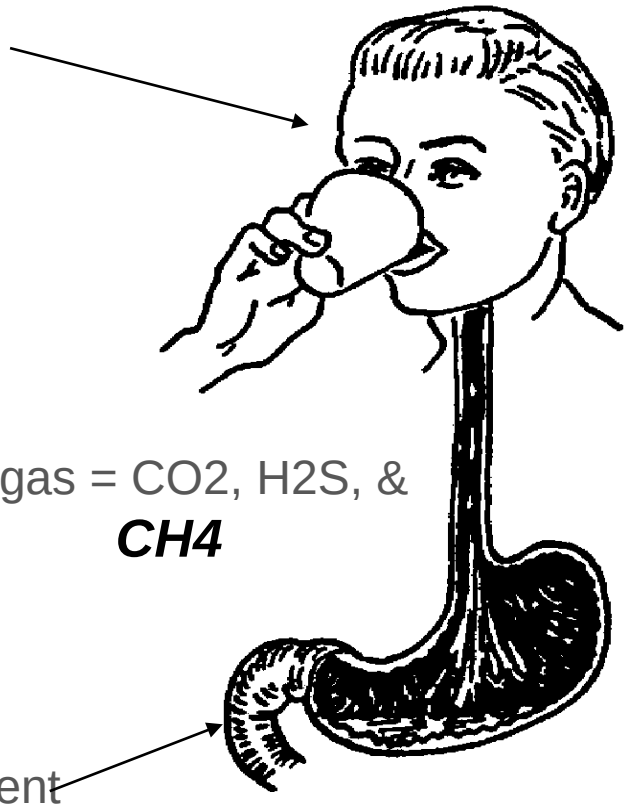
Anaerobic Digestion Basics

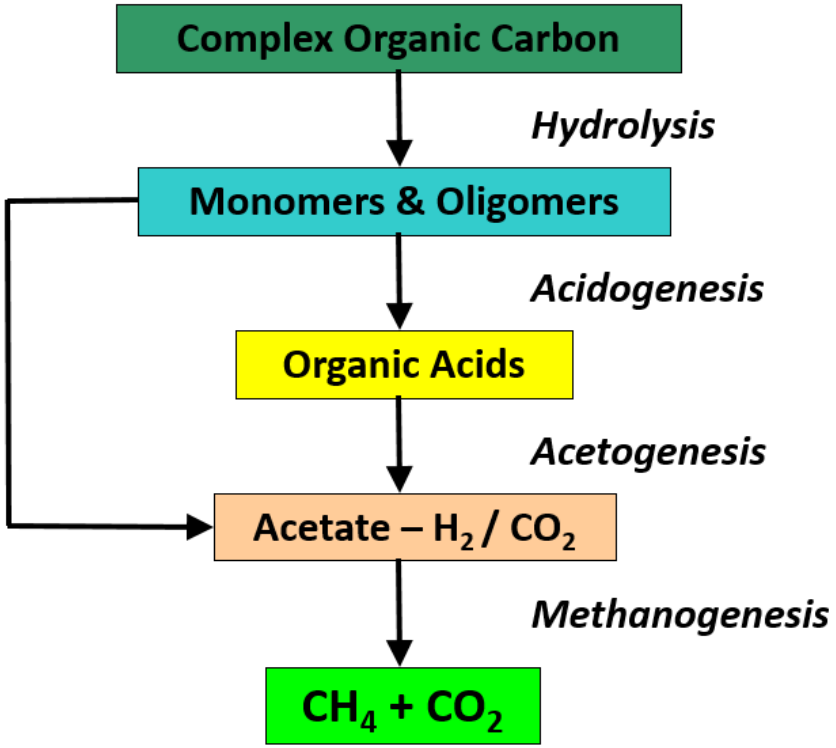
What are we really talking about?

Substrate (food)



Biogas = CO2, H2S, & ***CH4***

Effluent



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So what do we feed digesters?

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Feedstock:

What's Good?

- Undigested fats, proteins, carbohydrates = Gas
- Pre-established bacteria cultures
- Minerals for nutrients and buffering capacity
- Plentiful and consistent
- Fresh = Best
- Delivered = preferred

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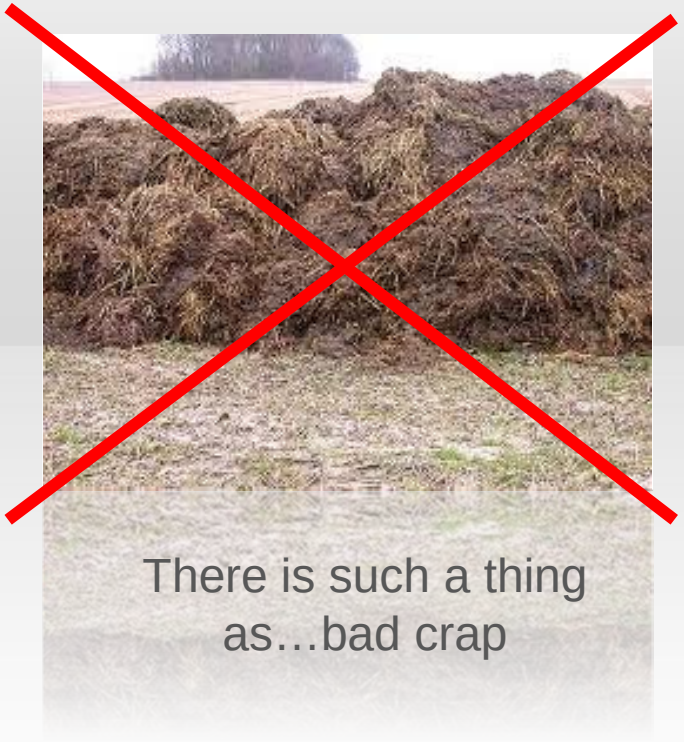
Feedstock:

What's not as good?

- Overly dried or composted manure – loss of VS "Other Stuff" that's not digestible:
  - Too much water, sand, rocks, rope, etc..
  - Plastic separation requires equipment and labor to manage
  - Dry Manure "Reject" Handling



There is such a thing as…bad crap

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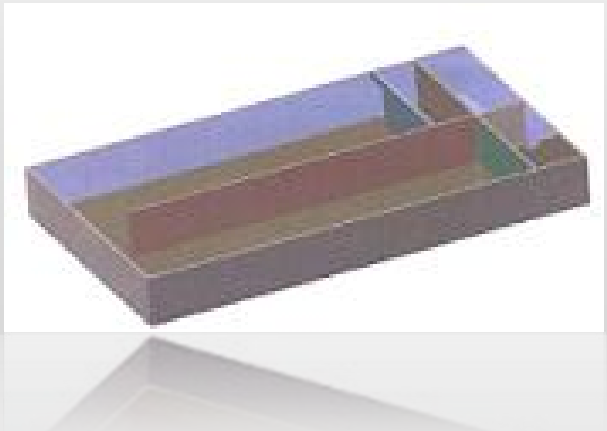
Anaerobic Digestion Basics

Whose on the market?

GHD: meso plug and mix combo in-ground

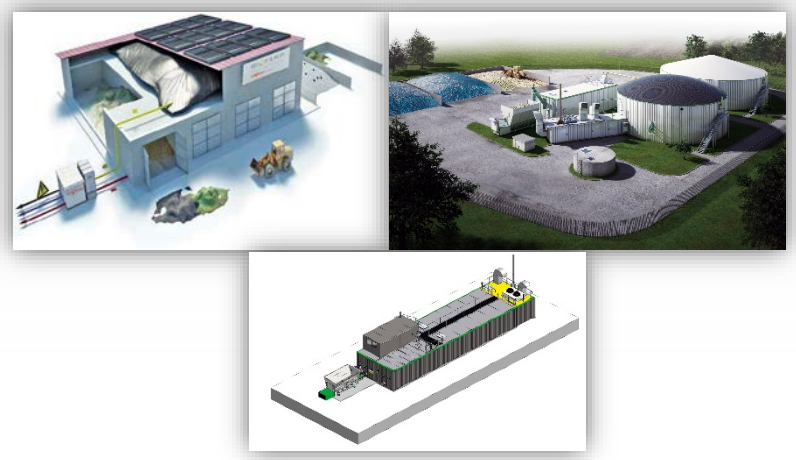


Eisenmann: plug flow

Biogas Nord: continuous meso mix

RCM
Kompoferm
UTS Biothane
CH-Four
Ecovation
MT-Energie
Entec biogas

BIOFerm: Dry Fermentation, Plug flow, CSTR, Compact



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Common Misperceptions in the Industry

- AD reduces waste
- AD reduces phosphorus
- AD has no odor
- Low maintenance

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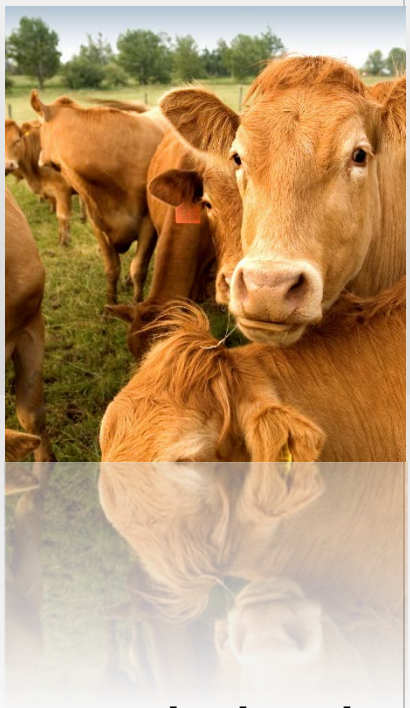
Waste Management and Energy Creation Across Sectors

Municipal Solid Waste

Wastewater

Industrial



Agricultural

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Municipal Solid Waste

A typical case…

Cost:

- $28m
- OP-EX estimated $450,000/yr
- Payback (?)

Feedstock:

- 40,000 metric tons/year high-solids organic waste
  - Municipal solid waste
  - Source Separated organics from industrial, commercial, and institutional waste sectors
  - Yard Waste

Average Annual Energy Production:

- 12.5 Million kWh electrical
- 45,300 MMBTU thermal

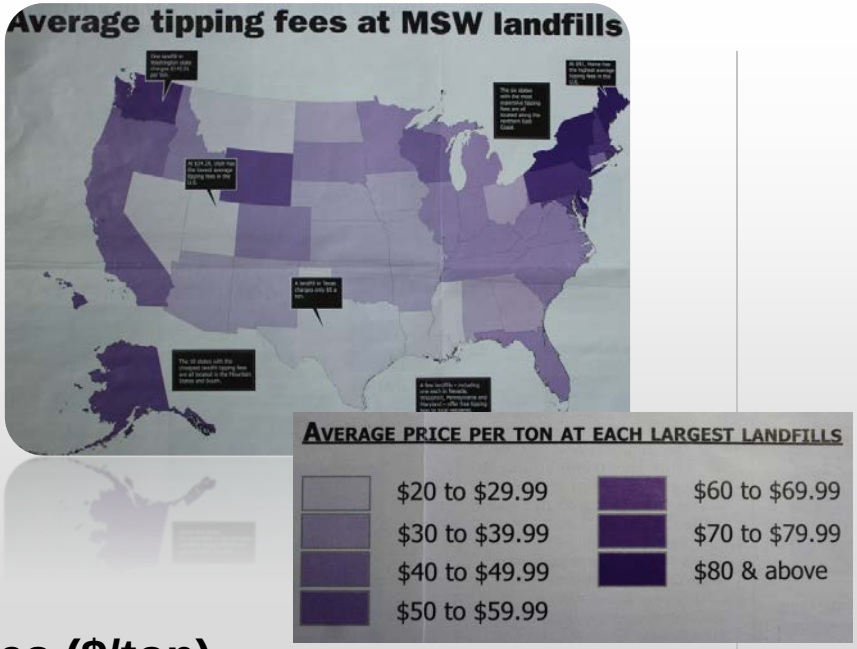
Biogas Produced:

- 60 Million scf

Emissions Reduced:

- 46,000 metric tons CO_2/year

Where does a project make financial sense?



Tipping Fees ($/ton)

State	High	Low	Avg
Washington	$142	$28	$70
Maine	$115	$72	$91
Pennsylvania	$103	$63	$76
New York State	$102	$49	$86
Wyoming	$102	$35	$60
Massachusetts	$100	$60	$78
US Average			**$50**

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Based off of BIOFerm's Project with the City of Edmonton, Alberta Canada

Wastewater Treatment & Industrial

A typical case…

Cost:

- Phase 1 $7 million
- Phase 2 $32 million
- Opex (?)
- Payback (?)

Feedstock:

- 7,000 dry tons biosolids/year
- 15,000 dry tons biosolids/ year

Average annual energy production:

- 3 Million kWh electrical
- 11,796 MMBTU thermal
- 47,733,850 ft^3 biogas at 55% CH_4

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Based off of BIOFerm's Project with the City of Akron, OH and KB BioEnergy

Agricultural

A typical case…

Cost:
- $7 million
- $864,000/ year
- Payback (?)

Herd Size:
- 9,000 dairy cows

Processing Capacity:
- 350 tons of manure/day

Average annual energy production:
- 11-12.5 Million kWh electrical
- 45,300 MMBTU thermal
- 165,000,000 ft^3 of biogas

Emissions Reduced:
- 44,602 metric tons CO_2/year

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Based off of BIOFerm's Project with the University of Wisconsin Oshkosh and Rosendale Farm

A closer look into Municipalities: Waste-to-Energy

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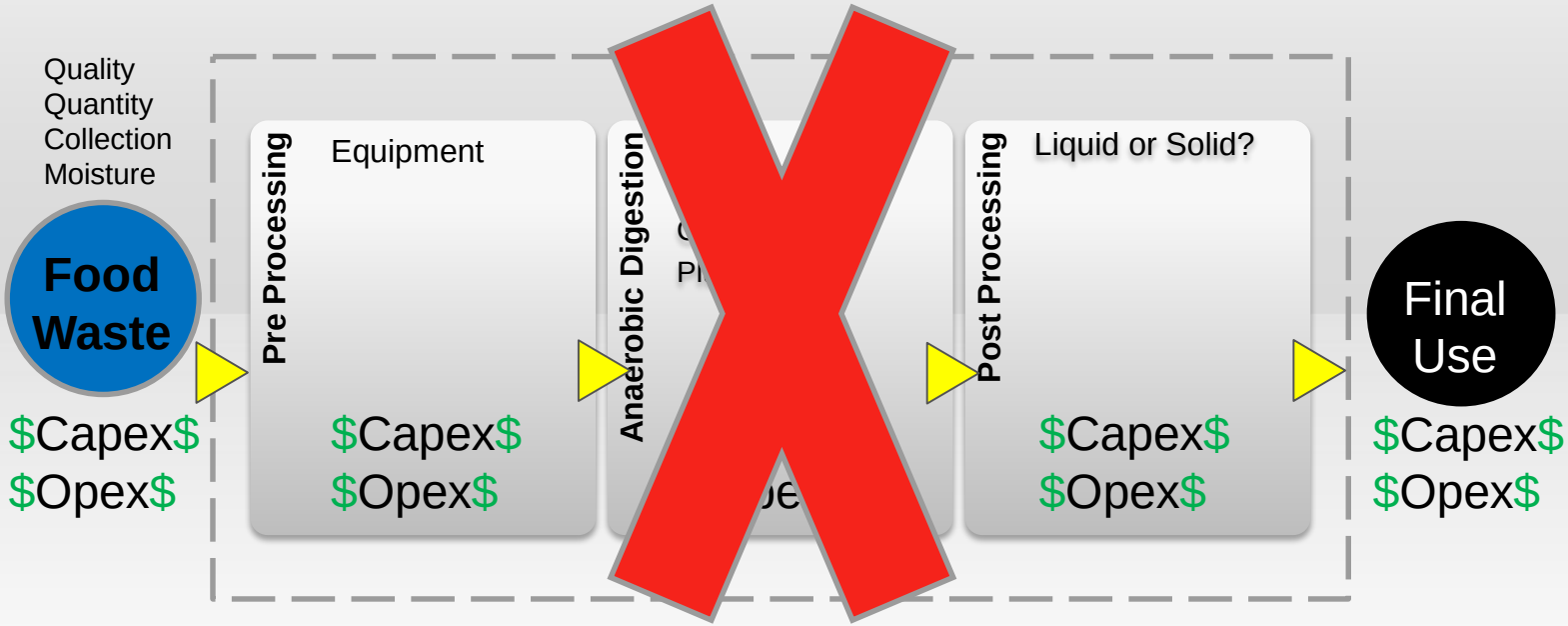
PFD of Municipal Process



MSW Collection Considerations

- Collection
  - Single-Stream
  - Residential Separation
  - Frequency
- Residence Times
- Hauling Distances

Images courtesy of Google

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Typical MSW Generation (Before Recycling/Diversion)

Photo courtesy of BioCycle.net, information courtesy of 2012 EPA Estimates

• Paper	27.4%
• Food Waste	14.5%
• Yard Waste	13.5%
• Plastics	12.7%
• Metals	8.9%
• Rubber/Textiles	8.7%
• Wood	6.3%
• Glass	4.6%
• Other	3.4%

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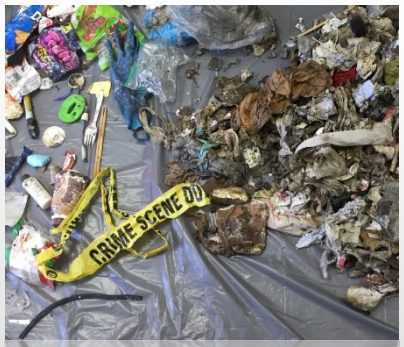
Waste Characterization



- Waste Constituents
  - Contamination
  - Physical properties

- Laboratory Testing
  - Total & Volatile Solids
  - Biogas & Methane Potential

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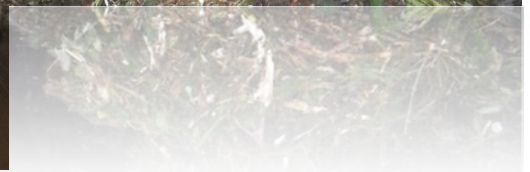
Pre-Processing Considerations

- Equipment
  - Debaggers
  - Shredders
  - Magnets
  - Trommels



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Pre-Processing Considerations

- Equipment
  - De-packager

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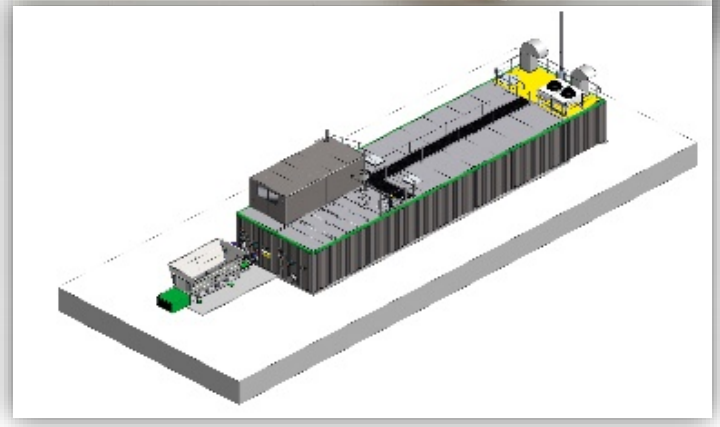
Digestor Considerations

- Dry Fermentation
- CTSR
- Plug Flow



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Post processing Considerations

- Digestate end use- adding value
- Handling Solid vs. Liquid waste
- Capturing nutrients

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High-Solids AD- Non-Pumpable Materials

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Anaerobic Digestion - Non-Pumpable Materials

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What to consider when interested in buying a Biogas Plant

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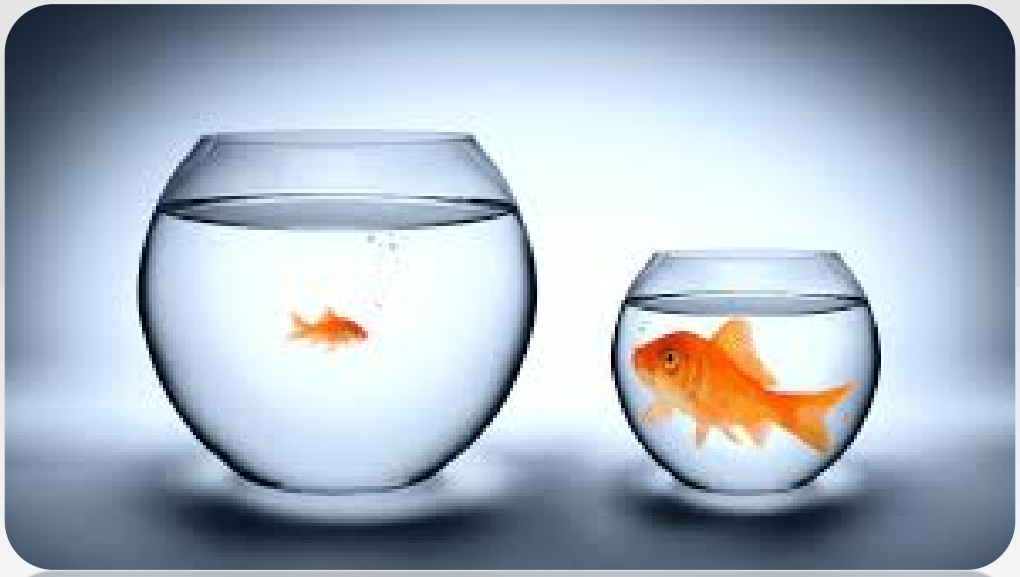
Is bigger always better?



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A Comparison of European to US AD Application

- A Tale of Two Policy-driven Markets

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Buying a Biogas Plant: Feedstock

Germany:

- Majority of feedstock is energy crops (e.g. corn and grass) and manure
- Well known and highly consistent substrates
- About 20% of plants run on municipal organic waste

USA:

- Growing biomass not widely accepted (food vs. fuel debate)
- Use waste streams, e.g. manure, source separated organics
- **Potential lies with source separated organics (34 million tons of food waste per year, only 2.5% is currently recycled)**

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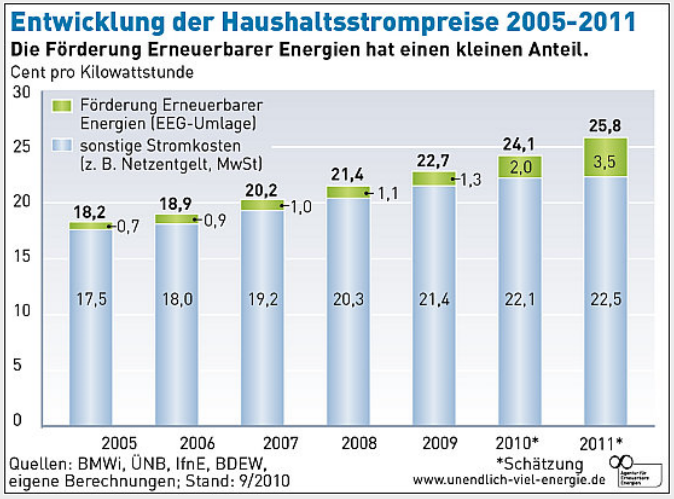
Buying a Biogas Plant: Economics

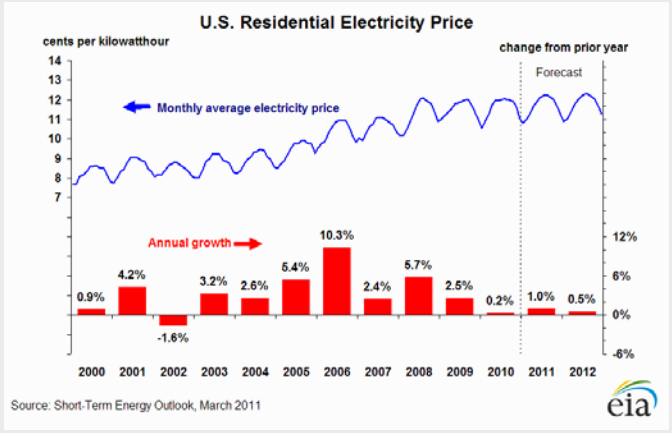
Germany:

- Electricity prices are higher compared to US
- Renewable energy is subsidized
- Biogas market competition is high, keeping technology prices competitive
- Time to payback, even for a small farm based system, is relatively short



USA:

- Electricity prices are low
- Renewable energy incentives: 30% tax grant/credit, other incentives vary from state to state
- Payback times are longer
- Collecting tip fee for organic waste will positively influence economics



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Buying a Biogas Plant:
Product Sales

Germany:

- Erneubare Energien Gesetz (EEG), Renewable Energy Law, revised in 2009 regulates feed-in tariffs for all renewable energy technologies, guaranteed for 15 – 20 years

Example Biogas:

EEG Biomass:	0.1167 €
Renewable Biomass Bonus	0.07 €
Manure Bonus	0.04 €
Technology Bonus	0.02 €

- **Total: 0.2467 €**

- **Retail Cost: Around 0.25 €/kWh**

USA:

- Has no country wide feed-in tariff
- Few states (e.g. Hawaii) have adopted them, but don't necessarily include biomass/biogas
- Each biogas client has to negotiate their own Power Purchase Agreement with their utility

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Buying a Biogas Plant: Financing

Germany:

Financial instruments exist to finance biogas plants:

- Project economics clearly defined
- Proven application of technology
- Standard safety certification of plant technology (TÜV)
- Risk assessment is quantified by DIN standards

USA:

No defined financial instruments exist to finance biogas plants:

- Project economics do not follow a set model
- Unproven technical track record in the US
- Standard safety certification does not exist
- Risk assessments based on foreign data

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Buying a Biogas Plant: Permitting

Germany:

- Federal standards:
  - BImSchG: Federal Emission Control Law
  - EG-Hygiene VO: European Hygiene Regulation for animal products
  - TA Luft: Technical Instructions for Emission Control
  - TA Lärm: Technical Instructions for Noise Control
  - DMG: Fertilizer Law
  - BioAbfVO: Municipal Organic Waste Regulation
- Safety and expert reports available (TÜV)
- Permitted per component unit, e.g. digester tank, biofilter
- Over 5000 plants permitted

USA:

- No federal standards
- No standard safety certifications
- State standards for emissions (CHP emissions), differ from state to state
- Building codes vary from one state to another

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Challenges with Anaerobic Digestion
Decision Checklist

- Who is designing your biogas plant? What is their experience in the local market?
- What is the financial strength of the company that is selling you a system? How committed are they to the market in your country?
- How many engineers, support staff etc. are located in your market?
- Who is guaranteeing that the system will work through the initial warranty and long term operation?

Challenges with Anaerobic Digestion
Decision Checklist

- Who is guaranteeing that your feedstock will produce the stated amount of biogas?
- Who provides ongoing biological support for your biogas plant? Are long term service contracts available?
- Who provides ongoing technical support and service locally?
- What kind of lead time can you expect and tolerate for replacement parts?

Challenges with Anaerobic Digestion
Conclusions

- Careful selection of technology provider. Must have a good track record
- AD is a complex biological system, and adequate training of operational personnel is required
- There is no “one size fits all” because feedstocks will differ on a case by case basis, and this has to be taken into account during the design and operation of the system

Thank You!

At BIOFerm™ we see our role as “re-definers” of waste across a variety of sectors. We hope to provide the tools for industries to make the most of the resources within their reach–

because nothing is waste until you waste it.

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