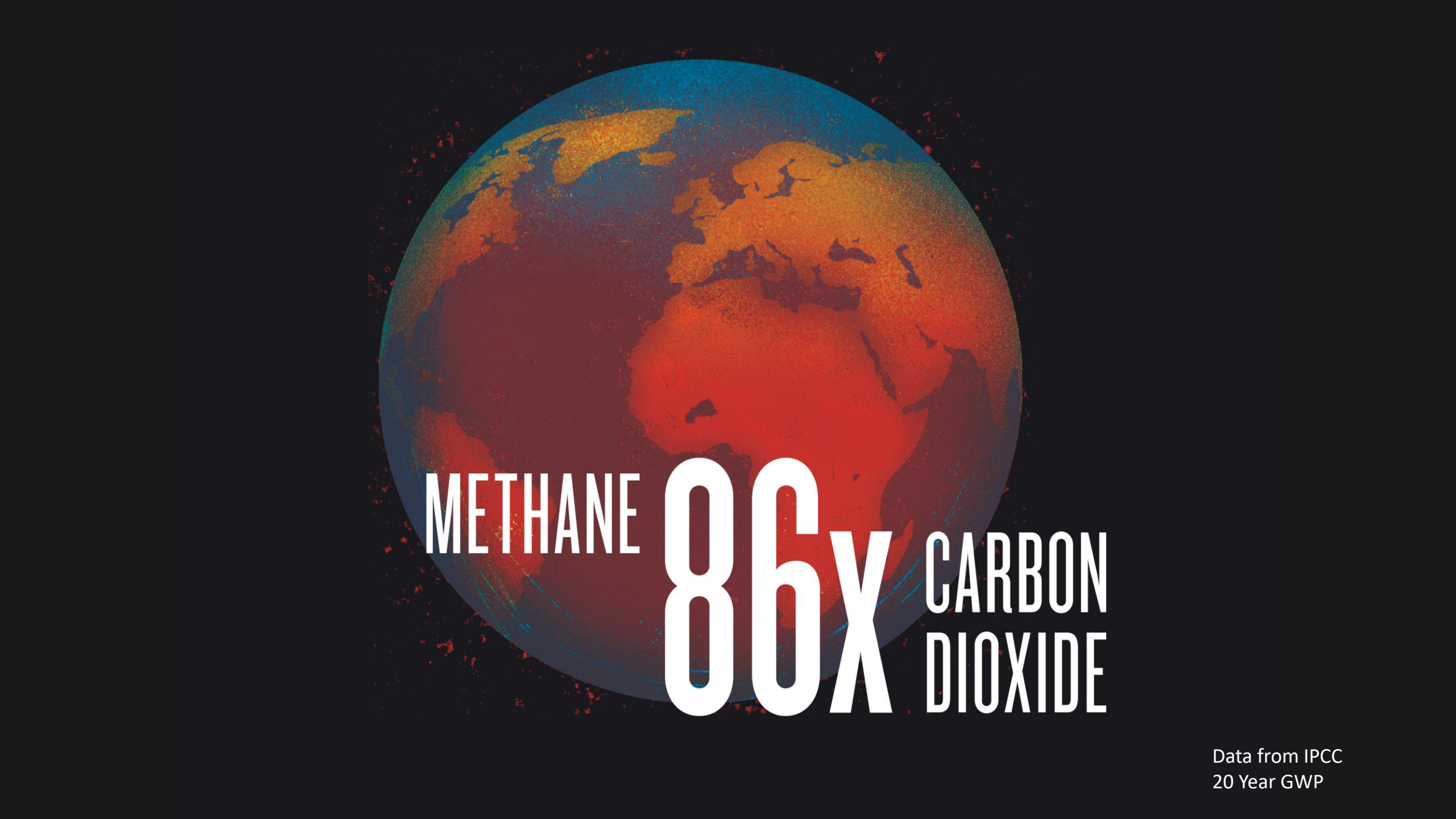
SIERRA ENERGY

FastOx® Gasification

Converting waste to power and profits


IN 2025 THE WORLD WILL PRODUCE 2.2 BILLION TONS OF WASTE
Data from World Bank

Data from EPA



Data from IPCC
20 Year GWP

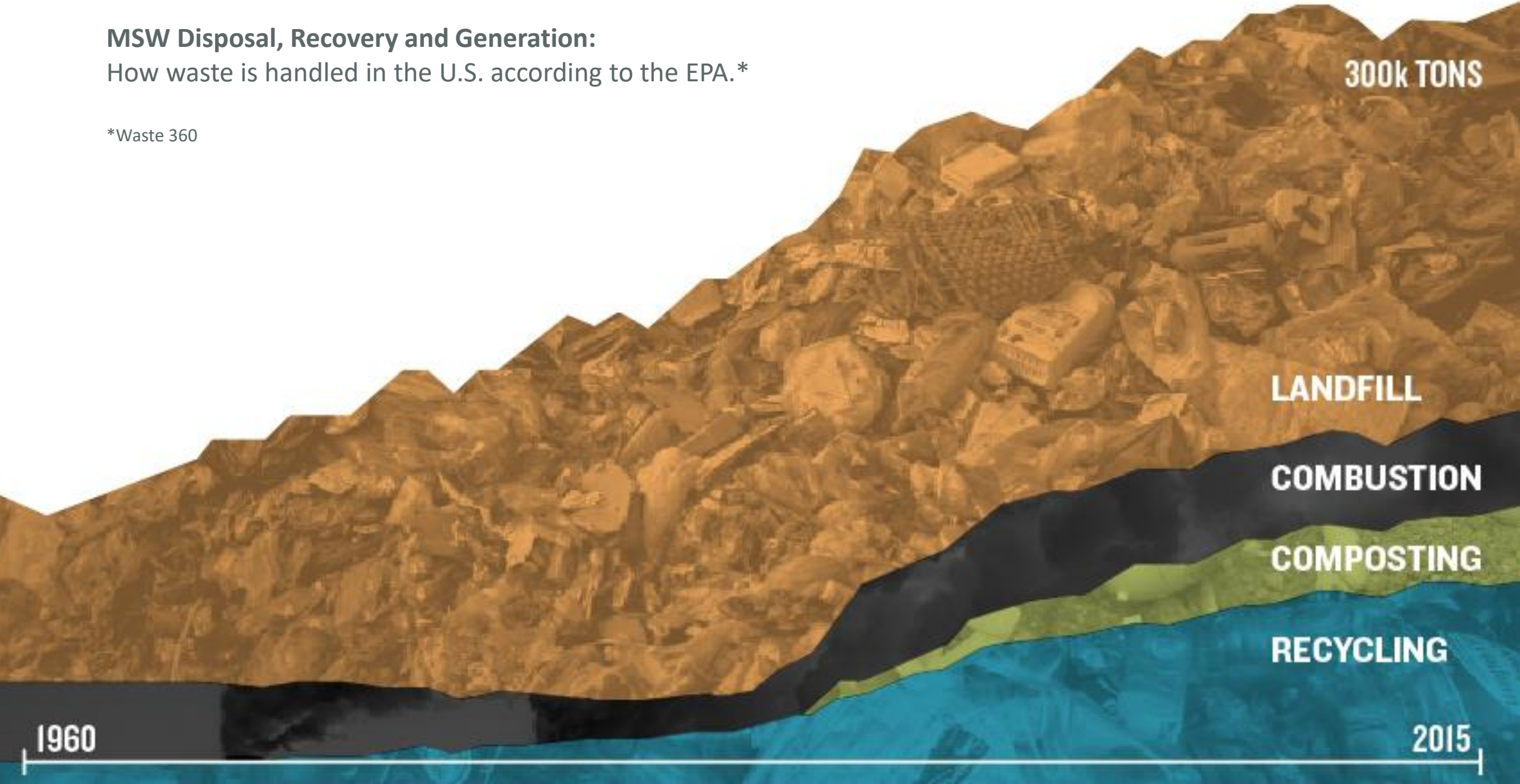
2.2 BILLION
TONS OF WASTE

13.6 BILLION
TONS OF GHG

300 GIGAWATTS
BASELOAD RENEWABLE POWER
DISTRIBUTED TO WHERE PEOPLE ARE

MSW Disposal, Recovery and Generation:
How waste is handled in the U.S. according to the EPA.*

*Waste 360



CHINA POLICY LEAVES WORLD DROWNING IN RECYCLING

INCINERATION IS A BAD SOLUTION

Poor on the environment
and poor economic returns

The U.S. has 210 commercial incinerators, with total capacity of 100,000 Tons Per Day

Data from Energy Justice Network

Sierra Energy

- Waste to clean energy company
- Proven FastOx® gasification technology developed and tested with the US Army
- Highly profitable solution
- Significant IP (patents and trade secrets)
- Global partners to build and deliver systems
- Large pool of screened customers
- Reduces GHG by eliminating landfill methane emissions
- Experienced management team

Sierra Energy HQ, Davis CA

Sierra Energy

Funding Timeline

2004-18
Sierra Railroad Company
$30M

2012
Department of Defense
$3M

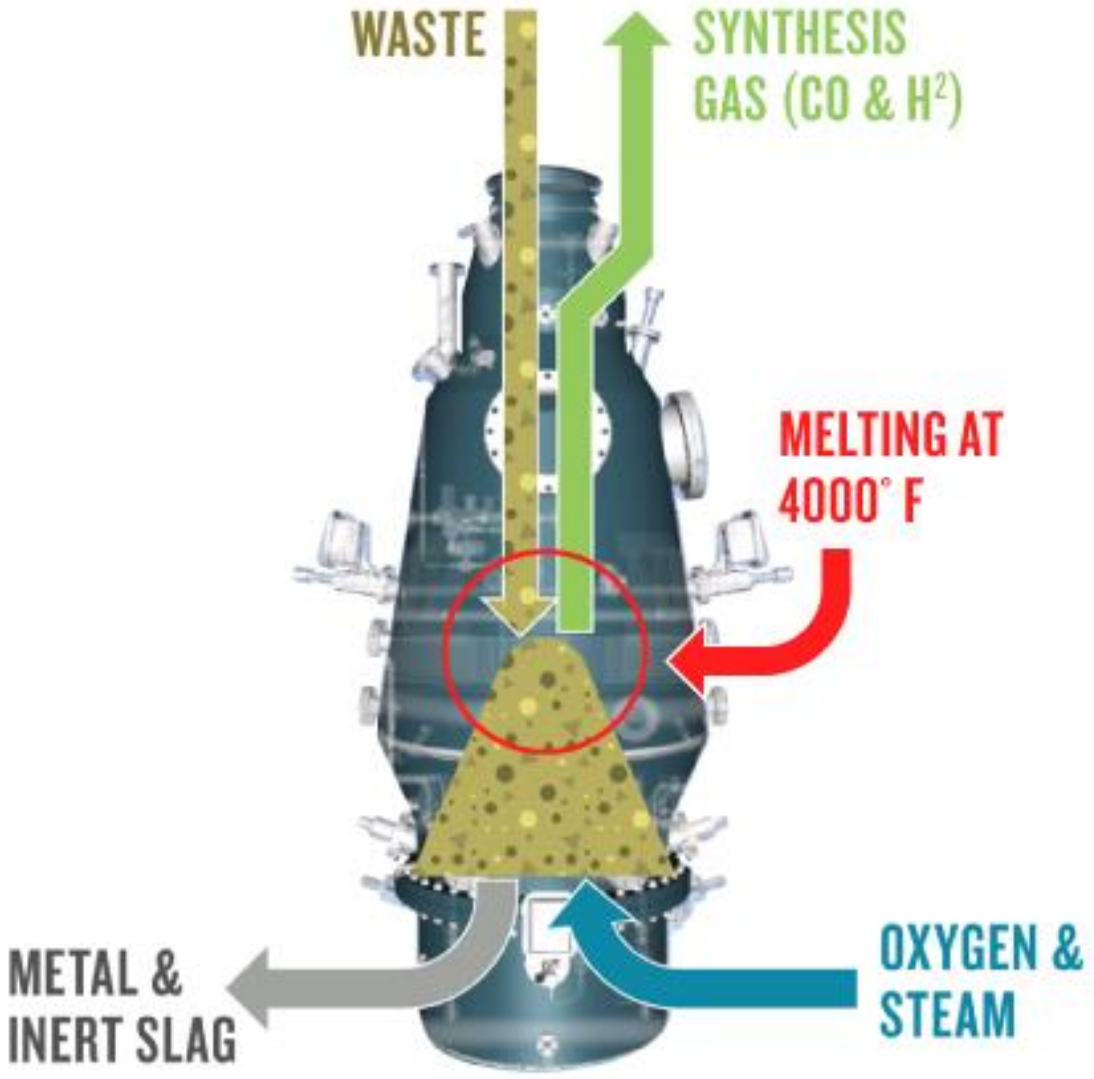
2013
California Energy Commisson
$5M

2019
Series A
$33M

Waste Diversion / Conversion Technologies

Recycling	Composting	Anaerobic Digestion	Aerobic Digestion
Pyrolysis	Downdraft Gasifiers	Indirectly-heated Gasifiers	Multi-vessel, Multi-process Gasifiers
Fixed-bed Updraft Gasifiers	**FastOx Gasifiers**	Fluidized Bed Gasifiers	Microwave Plasma
Molten Baths	Thermal Depolymerization	Methane Capture	Incineration / Mass Burn

FastOx® Gasification: The Future of Waste

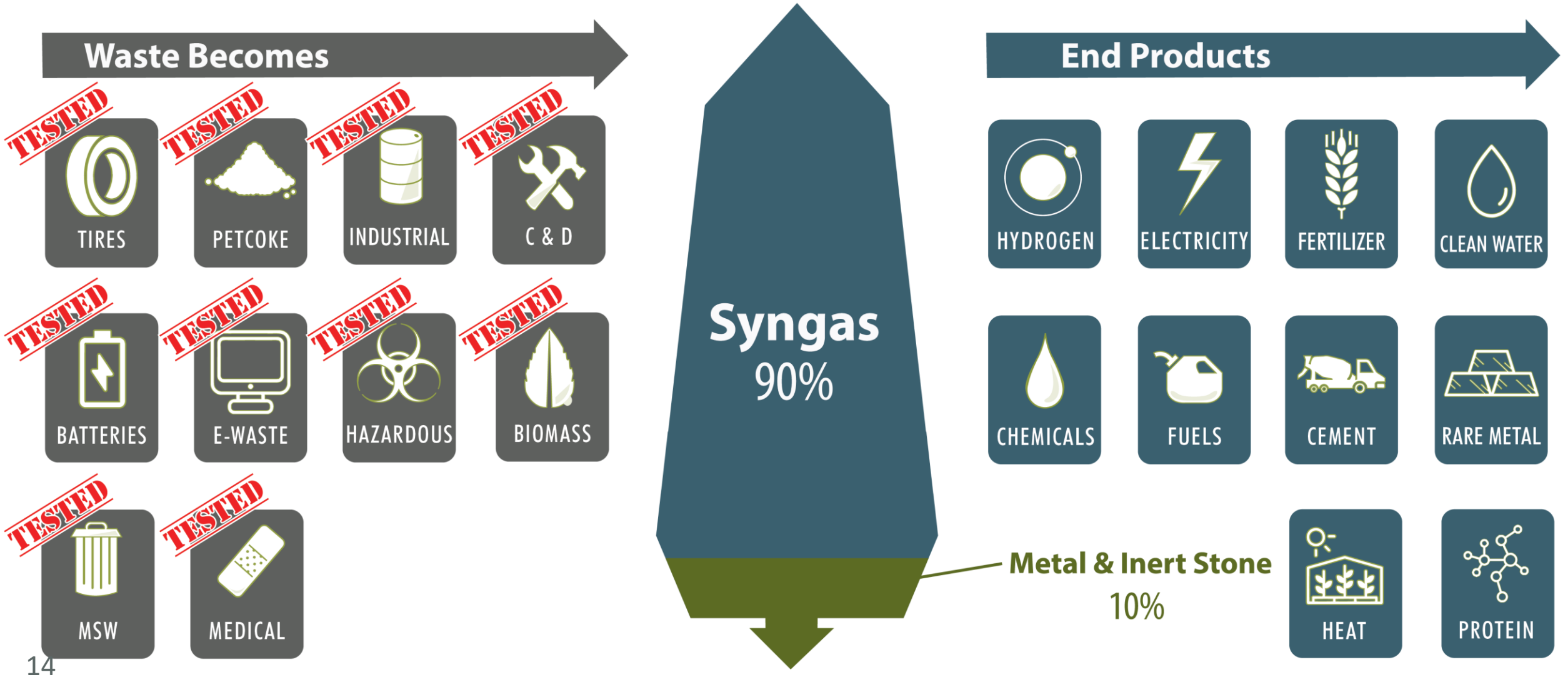


- System gasifies virtually any waste with no sorting required
- No process emissions
- Scalable from 50tpd systems up to several thousand tons per day
- Low maintenance with high up-time
- Low parasitic load
- All outputs are salable

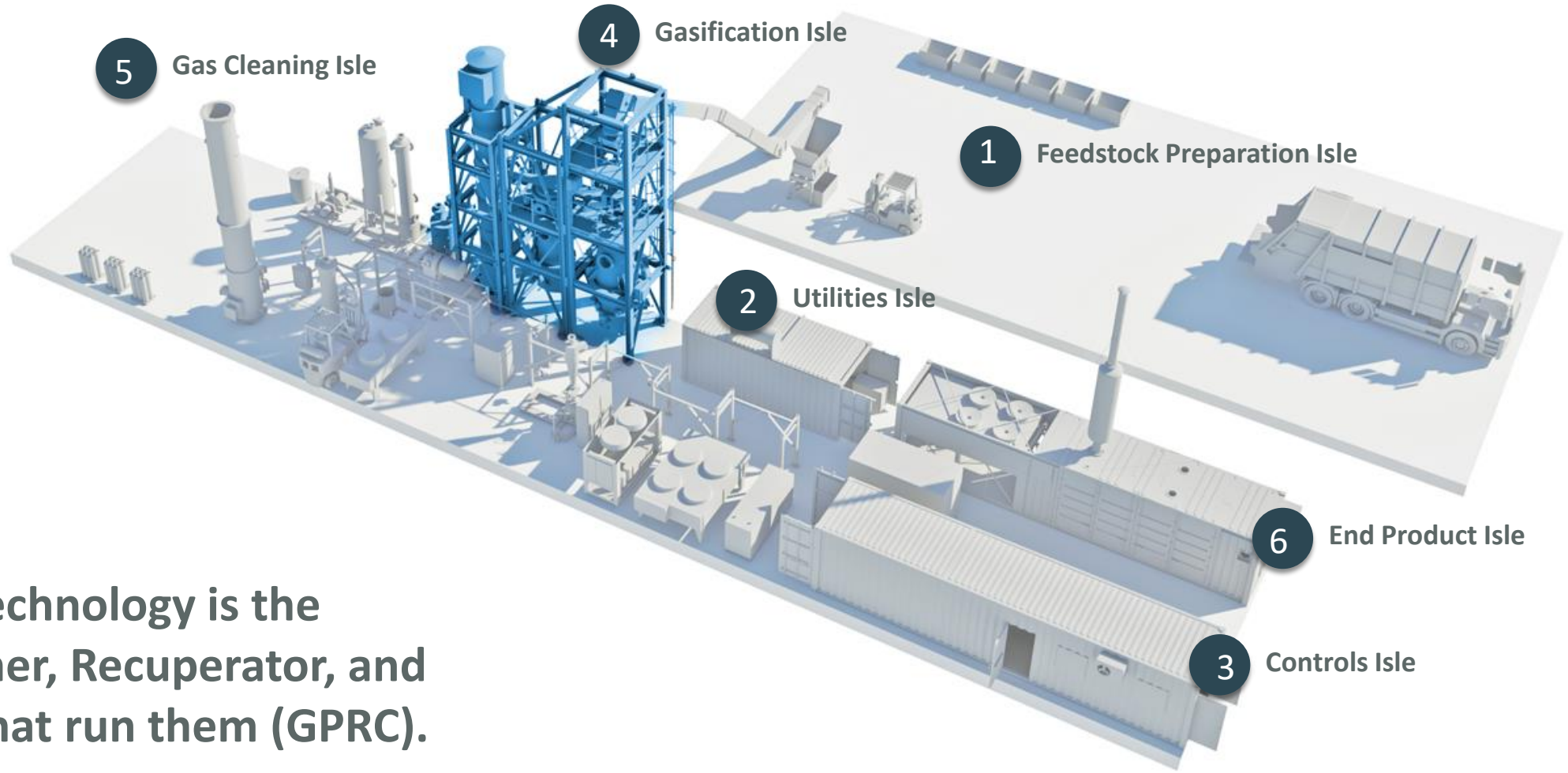
Advantages of FastOx® Gasification

- **Game Changer #1: O_2 Injection vs. Air**
  - **Improved process efficiency:** Increased productivity; high cold gas efficiency; decreased bed permeability requirements (therefore no coke)
  - **Improved syngas:** Enabling syngas recycle**;** smaller vessels and less CAPEX; lower emissions; increased fuel and gross electricity options
  - **Inert stone and recovered metals:** Melting/tapping; high temps generated through chemical reaction not plasma or fuel injection
  - **Lower parasitic load:** Better than other slagging gasifiers
  - **ROI/IRR improved significantly:** Even with cost of O_2 production
- **Game Changer #2: Existing Proven Vessel**
  - **Robust:** No moving parts; no restrictions in material flow
  - **Minimal waste processing:** Especially for metals / inert materials
  - **Low CAPEX:** Known technology
- **Game Changer #3: FastOx Polisher**
  - **Instantaneous conversion:** Avoid tars; increase syngas output

Waste Turns into High Value Products



Core Technology - GPRC



Sierra's core technology is the Gasifier, Polisher, Recuperator, and the Controls that run them (GPRC).

Core Technology - GPRC

- **FastOx Gasifier**
  - Feeding
  - Charging
  - Injection
  - Cooling
  - Tapping
- **Burners & Burner Management**
  - Including Syngas Recycling
- **Polisher**
- **Recuperator** (Heat Recovery)
- **Controls & Instrumentation**

FastOx® Facility at Fort Hunter Liggett

Fort Hunter Liggett Status

- Commissioning completed on wood waste
- Waste-to-syngas system has been brought online and all subsystems are undergoing test and DOX-based optimization:
  - Feeding
  - Gasification
  - Gas cleaning
  - Oxygen and steam production

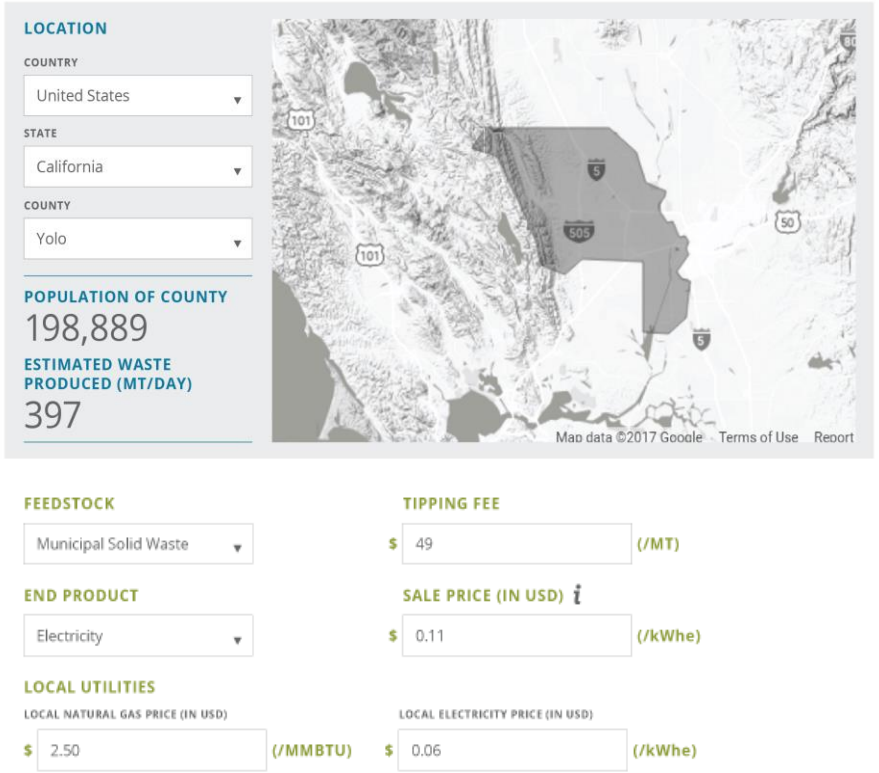
SIERRA ENERGY SECURES SERIES A

Fort Hunter Liggett commissioning leads to $33,000,000 investment round led by Breakthrough Energy Ventures with Cox Enterprises, BNP Paribas, Twynam, Formica and The March Fund.

BNP PARIBAS

Sierra Energy Calculator

Potential customers share valuable project data on local tipping fees, waste types, volumes and energy costs on the Sierra Energy calculator.



FastOx® Gasification: Profitable without Subsidies

SIERRA ENERGY

REPORT PREPARED FOR

Joe Smith, Landfill Owner

DATE

5/7/2018

FEEDSTOCK

Municipal Solid Waste

LOCATION

Yolo County, California

SYSTEM SIZE

50 TPD

END PRODUCT

Electricity

SYSTEM SPECIFICATIONS

System Size (MT/day): **50**
Primary Tipping Fee [/MT]: **$54.00**
Electricity Created [MWe(Net)]: **1.99**
Electricity Sale Price [/KWhe]: **$0.12**
Jobs Created: **13**

INVESTMENT ECONOMICS

Capital Investment: **$13,670,500**
Annual Operating Income: **$1,900,000**
Simple Payback: **7.2 years**
Annual GHG Savings: **108,000 $MTCO_2e/yr$**

ANNUAL REVENUES

Total Tipping Fee:	$986,000
Sale of Electricity:	$1,992,000
Sale of Recovered Materials:	$129,000
Carbon Credits:	$0
RIN Credits:	$0
Estimated Revenue:	**$3,107,000**

ANNUAL EXPENSES

Labor and Benefits:	$644,000
System Maintenance:	$306,000
Support Costs:	$197,000
Supplies and Materials:	$59,000
Estimated Expenses:	**$1,207,000**

OPERATING INCOME

Annual Revenue:	$3,107,000
Annual Expenses:	$1,207,000
Projected Income:	**$1,900,000**

HYDROGEN

Capital Investment (including est. Engineering):	$14,405,000
Annual Income:	$4,959,000
Simple Payback:	2.9 years

ELECTRICITY

Capital Investment (including est. Engineering):	$13,670,500
Annual Income:	$1,900,000
Simple Payback:	7.2 years

Note: Tipping fee is based on US average. Electricity sales price based on customer input average on SE online calculator tool. Heat recovery not calculated.

Thank you