FESC Florida Energy Systems Consortium

Universities Addressing Florida's Energy Needs

NCIIA

National Collegiate Inventors & Innovators Alliance

Landfill Gas to Liquid Fuels

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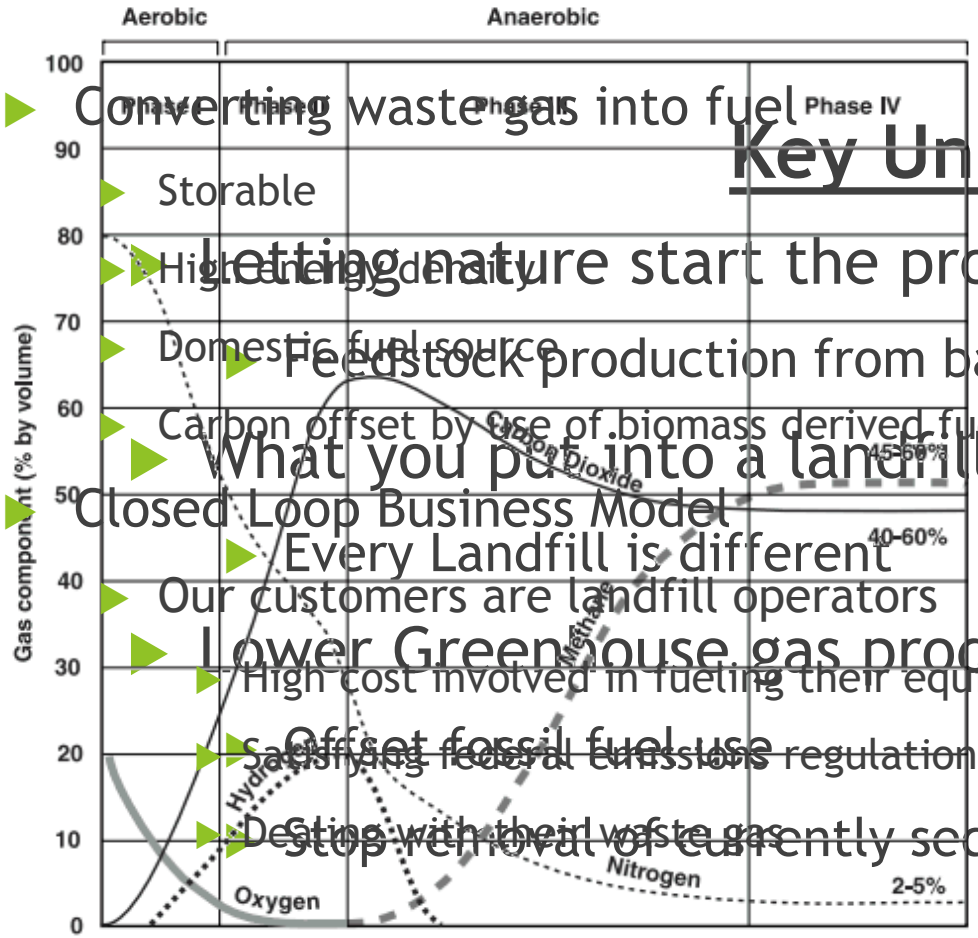
Objective

Develop a competitive process for the conversion of Landfill Gas (LFG) into liquid hydrocarbon fuels.

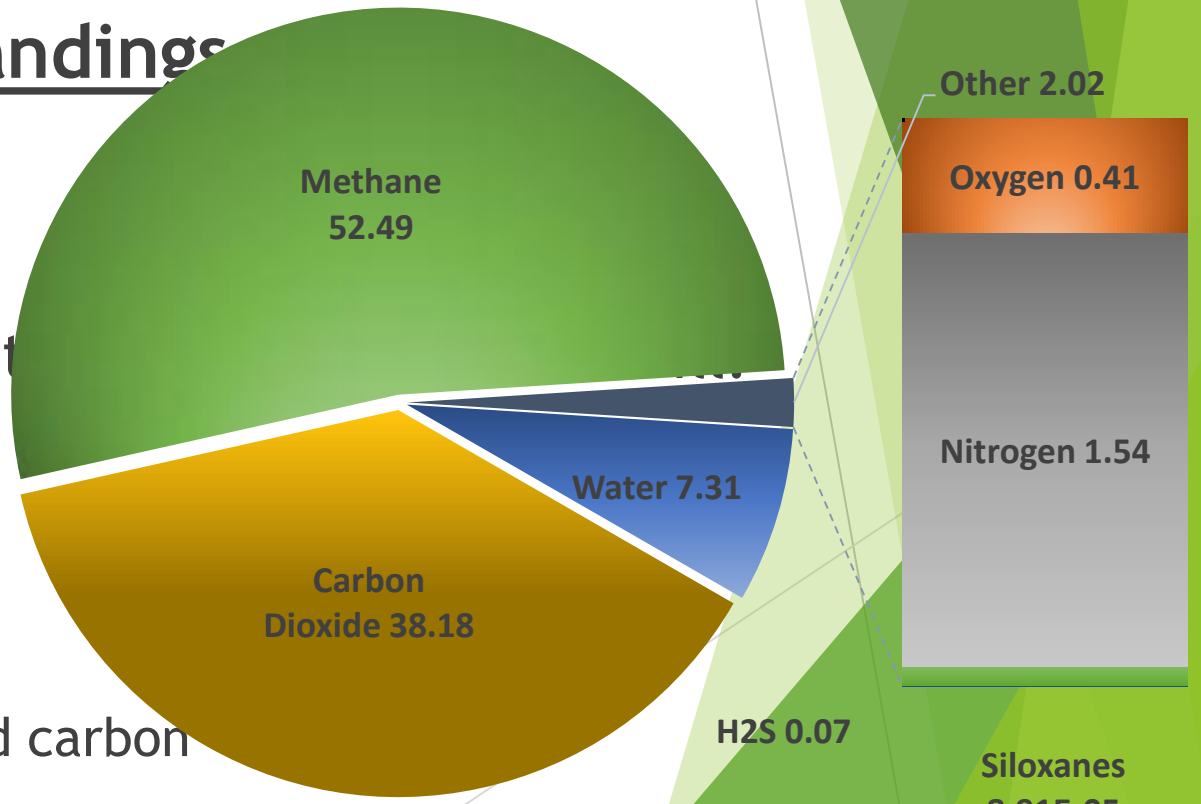


Note: Phase duration time varies with landfill conditions

Source: EPA 1997

Key Understandings

- Converting waste gas into fuel
  - Storable
  - High energy density
  - Domestic fuel source
  - Carbon offset by use of biomass derived fuels
- Closed Loop Business Model
  - Every Landfill is different
  - Our customers are landfill operators
  - High cost involved in fueling their equipment
  - Satisfying federal emissions regulations
  - Doing with their waste gas
- Lower Greenhouse gas production
  - Offset fossil fuel use
  - Stop removal of currently sequestered carbon
- Letting nature start the process
  - Feedstock production from bacteria
- What you put into a landfill is what



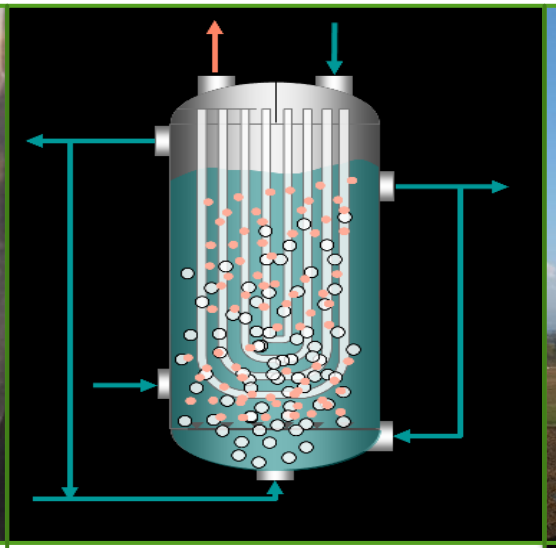
Motivation and Process

Pretreatment

- Iron Solid Scavenger
- Activated Carbon/Silica Bed

Tri-Reforming

- Convert LFG to Syngas
  - CO_2 Reforming
  - Steam Reforming
  - POx of Methane



Fischer Tropsch

- Convert Syngas to Long chain hydrocarbons

Separations

- High Quality Diesel
- Low quality gasoline sold for upgrading
- Unused portions to combustion

Compressed Natural Gas

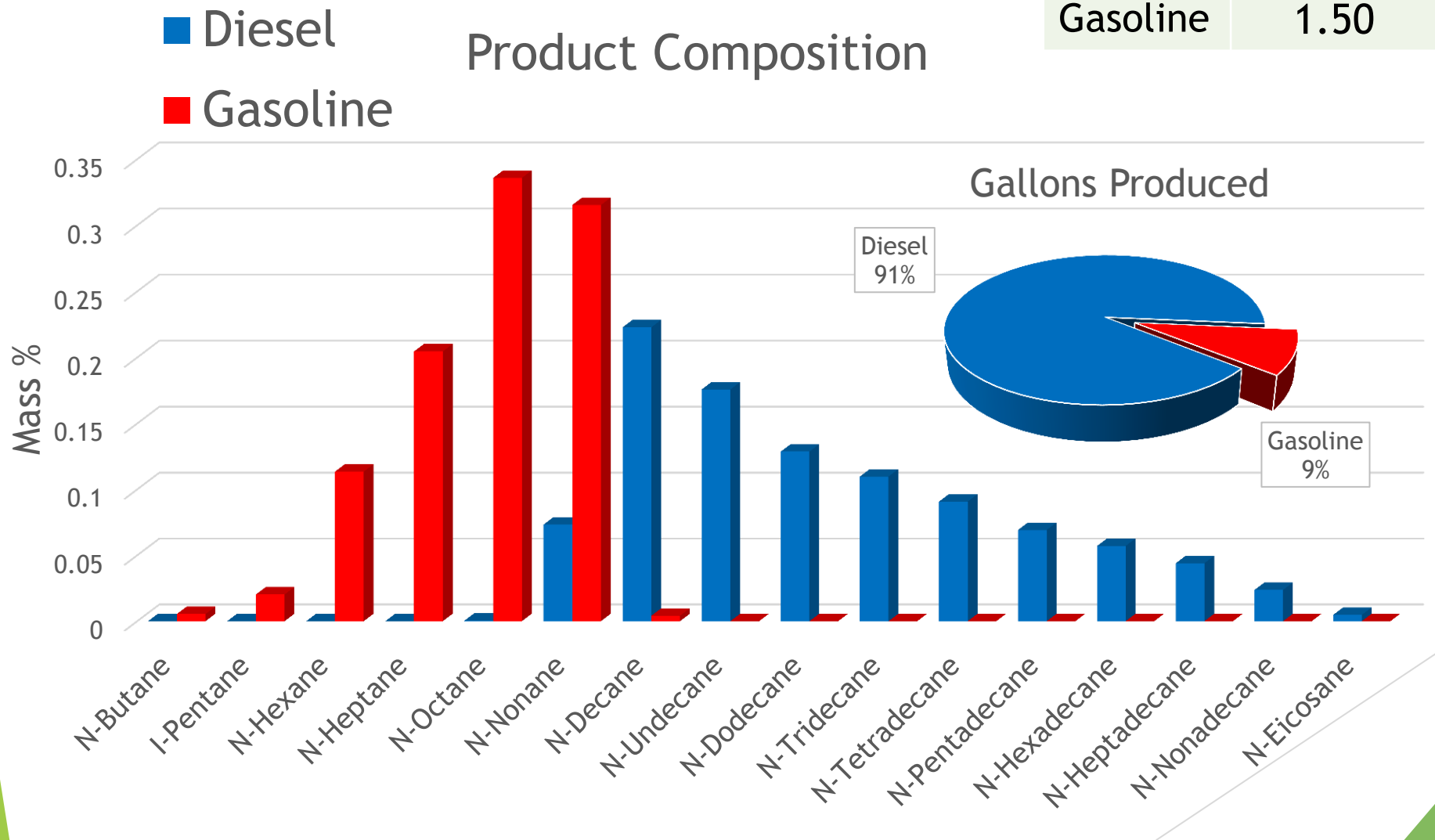
Liquid Hydrocarbon Fuels

- Siloxanes, Sulfides, Halides, etc.
- Modeling a competitive large scale process
  - Lab scale: 0.1 ft3/min (Kinetic data and reactor modeling)
  - Industrial Scale: (Using literature and industry data)
    - Process 2500 ft3/min

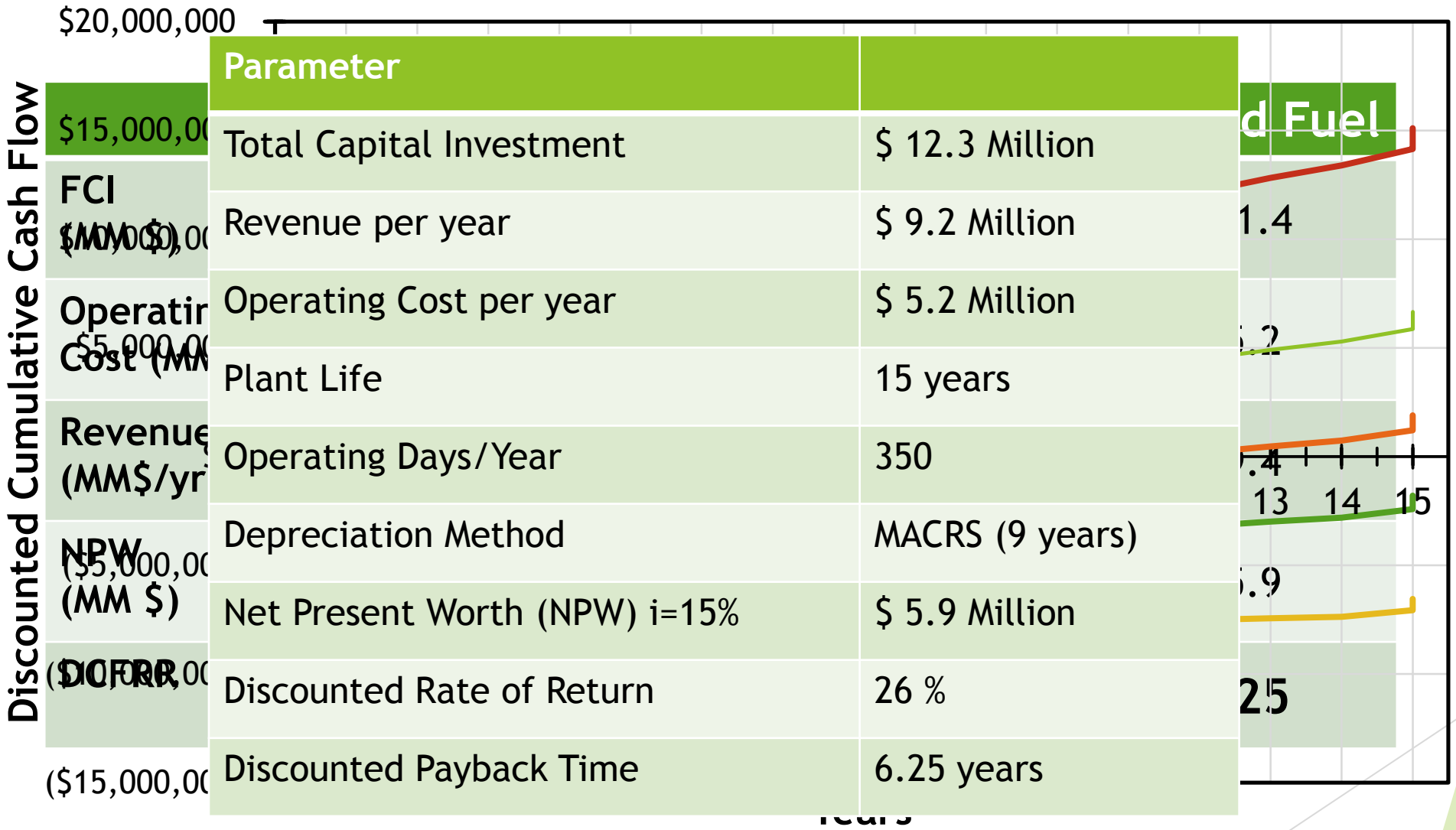
The Product

Diesel Properties	
Flash Point (C)	56.4
Freezing Point (C)	-36.2
Cetane Index	71.35

	Sale Price ($/gallon)
Diesel	4.00
Gasoline	1.50



Conclusions



Parameter	
Total Capital Investment	$ 12.3 Million
Revenue per year	$ 9.2 Million
Operating Cost per year	$ 5.2 Million
Plant Life	15 years
Operating Days/Year	350
Depreciation Method	MACRS (9 years)
Net Present Worth (NPW) i=15%	$ 5.9 Million
Discounted Rate of Return	26 %
Discounted Payback Time	6.25 years