CONVERSION OF FECAL SLUDGE TO LIQUID FUELS.
WHY AND HOW COULD IT WORK FOR SMALL-SCALE APPLICATIONS?

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AI3D

AI3D - Who are we?

Aliance for the innovation
in infrastructure and pipline integrity

- Education and Research on
  - Fluids transport infrastructure integrity management.
    - Water and Waste water
    - Oil and gas

- Strategic aliance with
  - Universities and research institutes = education and research
  - Private companies = projects excecution

Why are we here?

- Grand Challenges Explorations Round 7.
  Bill and Melinda Gates Foundation

- Objectives of the proposal:
  - Harness the energy contained in fecal sludge.
  - Storing it in the form of a high value fuel.
  - Turn fecal sludge into something valuable.
  - Make pit emptying more profitable and safe.

Outline

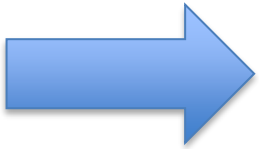
- Why liquid fuels from fecal sludge?
- How can it be done?
- Water content issues
- Fischer Tropsch process scaling
- Results of model
- Business model

Why liquid fuels?

Organic Matter in sludge = Energy

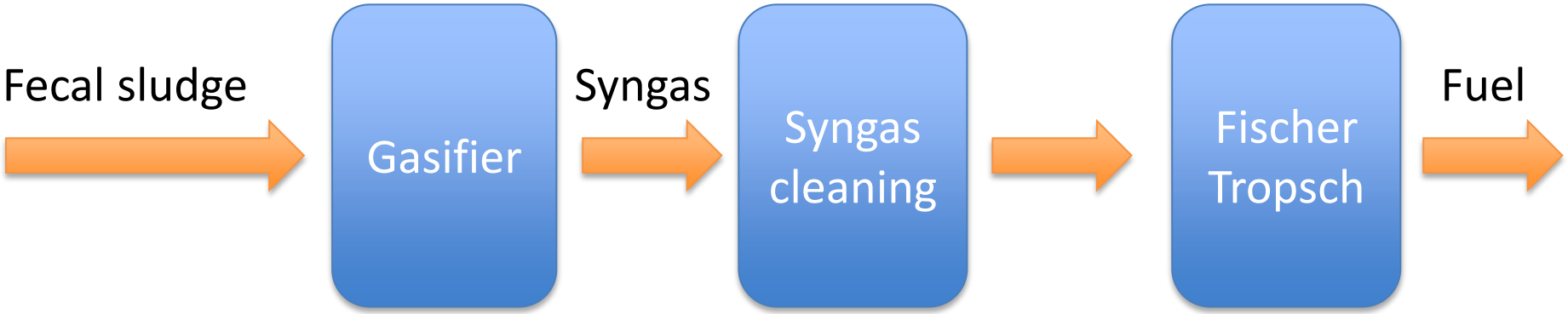
Liquid fuels (Diesel and Gasoline)

- High value
- Easy to transport
- Easy to store
- High demand



Value to
Fecal sludge

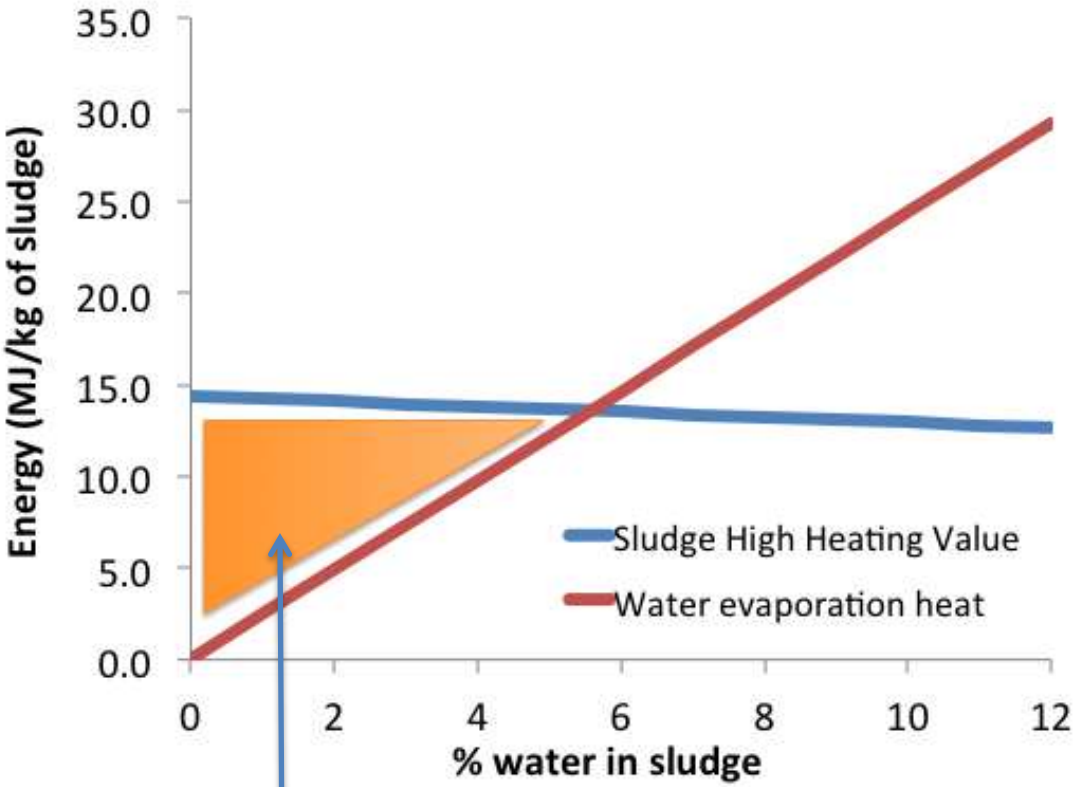
How can it be done?



Syngas: Mixture of $CO + H_2$

Fischer Tropsch: $(2n + 1)\ H_2 + nCO \rightarrow C_nH_{(2n+2)} + nH_2O$

What about the water?



Energy needed for drying !

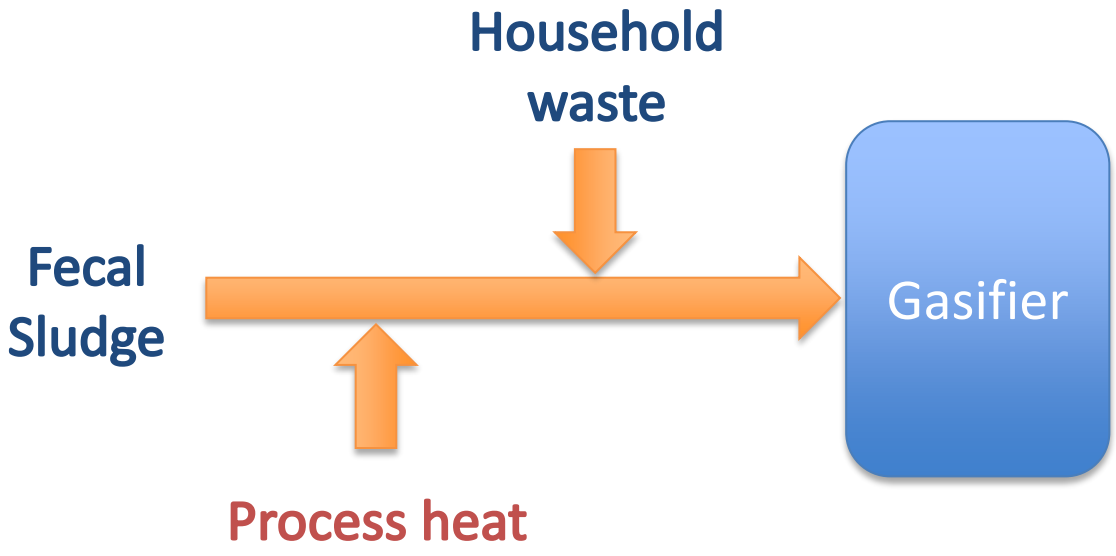
Excess energy

- Heat
- Electricity
- Storage

- Dried sludge
- Liquid fuels

What about the water?

- Energy for drying available from:
  - Process heat
  - Mixing sludge with other combustible waste



A way of getting rid of:

- **Solid waste**
- **Fecal sludge**

Fischer Tropsch Process Scaling

- Large industrial plants: thousands of barrels per day of liquid fuels

Economically viable for production capacity above 30,000 bbls/day

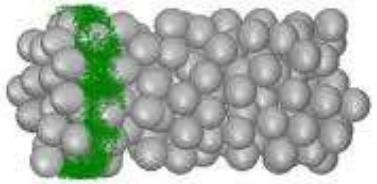
Process Intensification

Target production around 100 - 1000 L/day

Fischer Tropsch intensification options

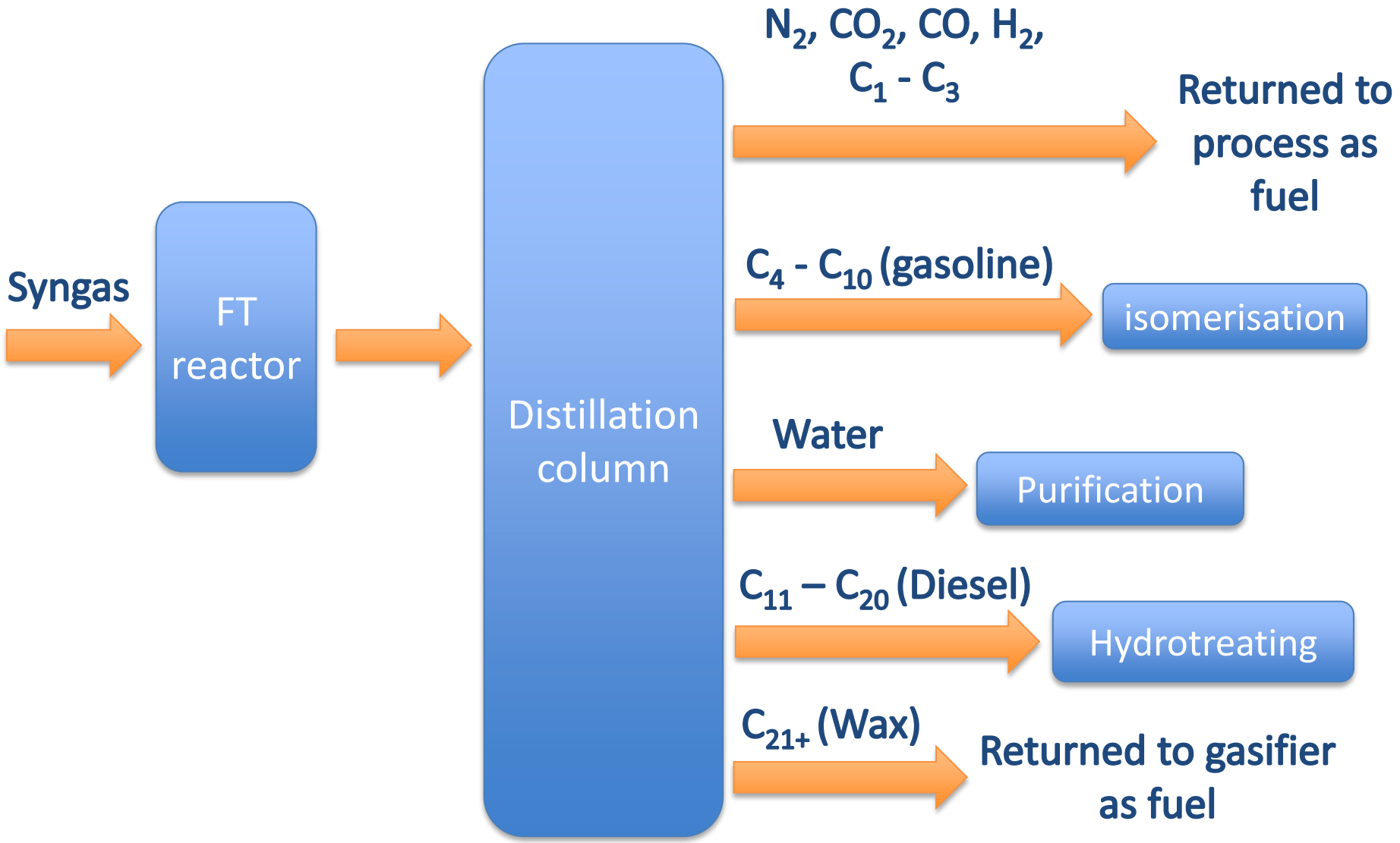
- Microchannel reactor (Velocys):

- Micro tubular reactor:



- Ceramic Monolith Reactor

Fischer Tropsch Refining



How much fuel can we obtain?

- According to our mass and energy balance of the process:
  - 11 - 31 Liters of gasoline and diesel per Ton of waste mixture.
  - Preliminary Energy Efficiency: 4 - 14 %
- Yield can be improved by:
  - Drying sludge below 22 % water content
  - Drying household waste

Business model

- Target capital cost: 750,000 USD/plant
- Target time to investment return: 3 to 6 years

- This will need:
  - 80 TPD of mixed MSW and Fecal Sludge
  - Central (mobile) processing plant
  - Satellite supplying vehicles (300 m radius)