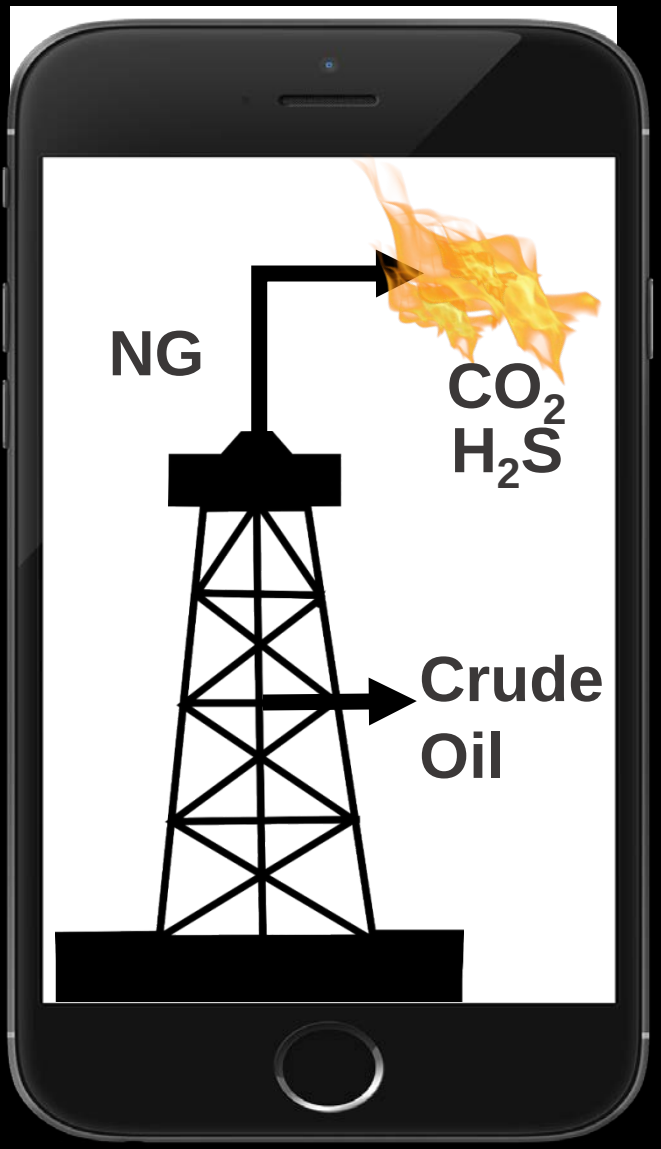
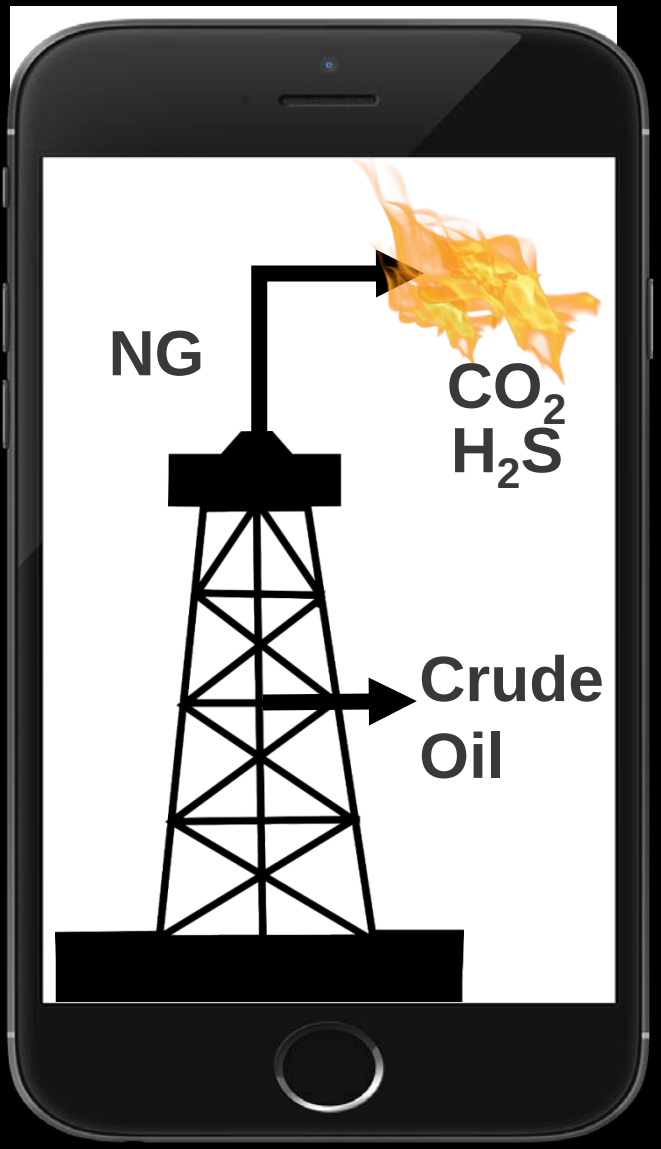
How to derive value from wasted natural gas?

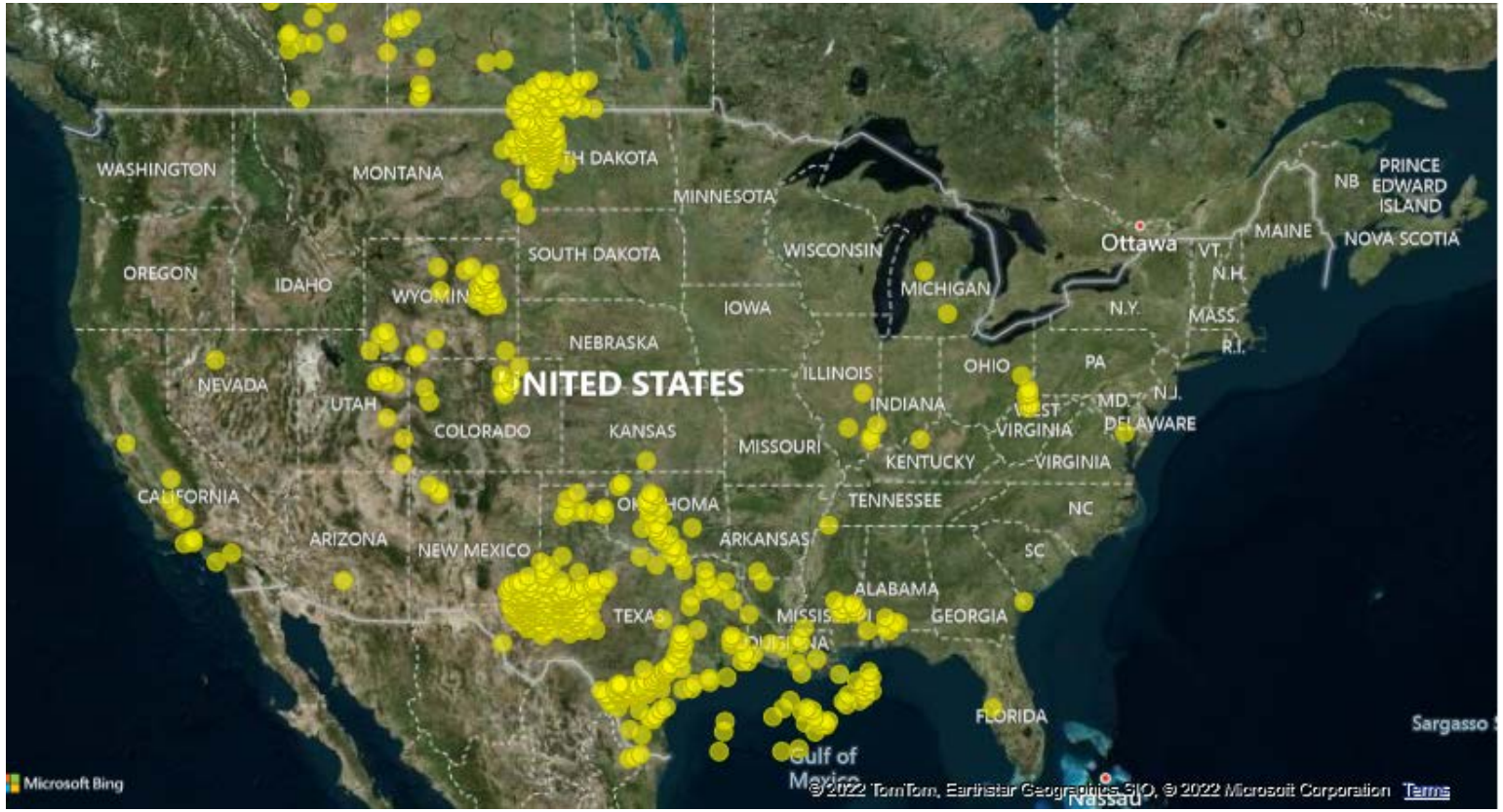
WASTED NATURAL GAS TO GREENER DIESEL



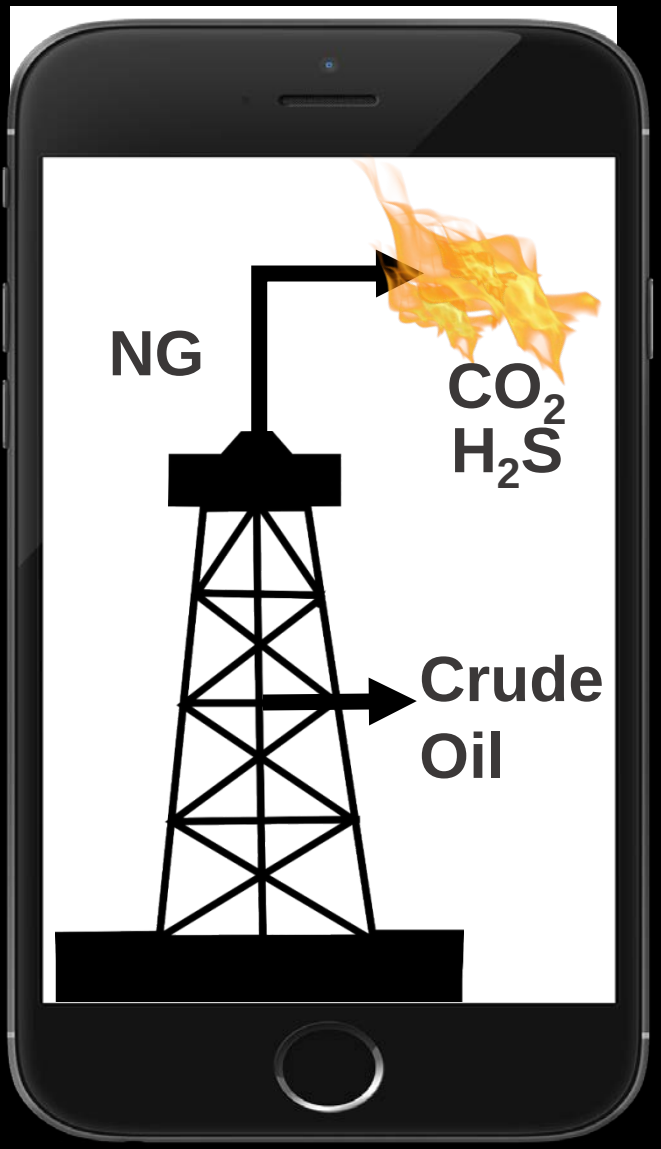
THE PROBLEM



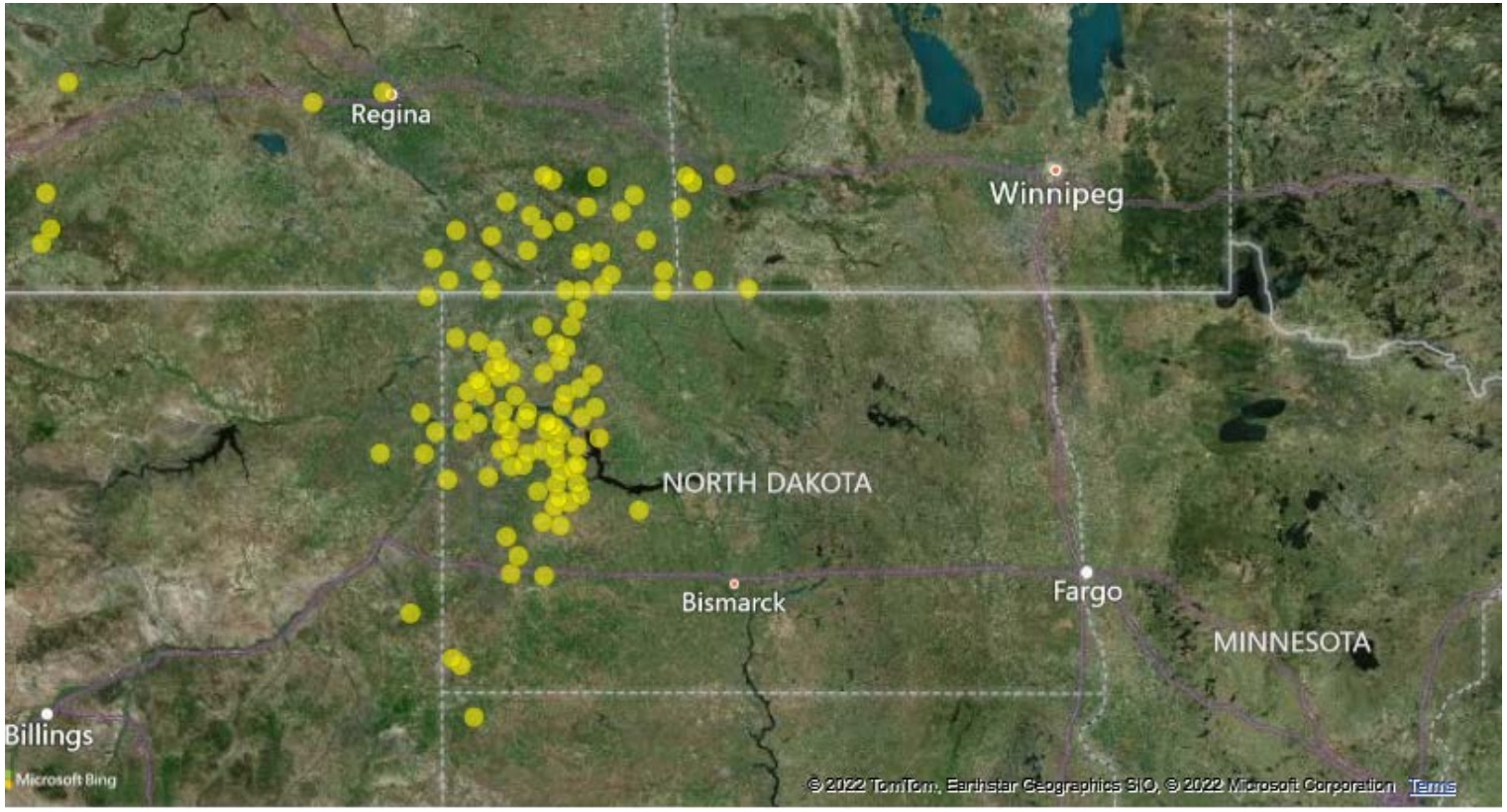
- Gas pipeline infrastructure uneconomic



THE PROBLEM



- Gas pipeline infrastructure uneconomic
  - Natural gas (NG) in remote regions
  - Pipelines costly: $100 000/mi/1” pipe diameter



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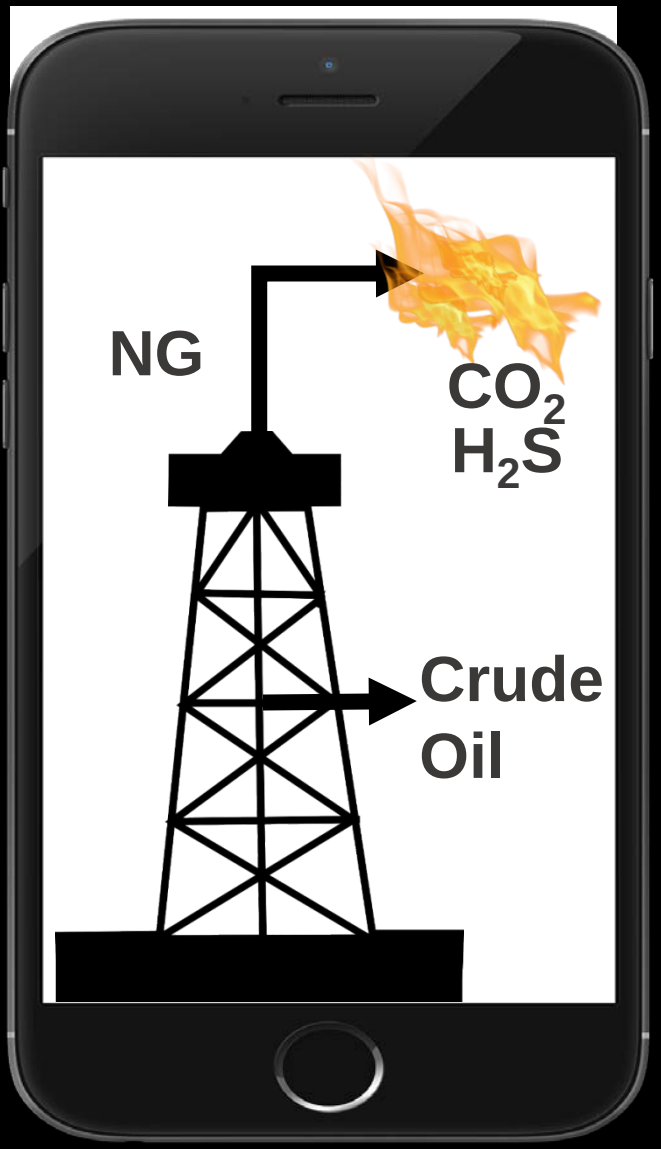


- Gas pipeline infrastructure uneconomic
  - Natural gas (NG) in remote regions
  - Pipelines costly: $100 000/mi/1” pipe diameter
  - Small volumes of NG

WASTED NATURAL GAS TO GREENER DIESEL

Technology	Micro refinery unit
TRL 5	TRL 9 in 2-3 years
Manufacturing	100 units within 5 y
Market	16 000 units for O&G world wide
Economics	Margin: $200 000/unit
Threats	Electricity, price fluctuations...

THE SOLUTION: micro units

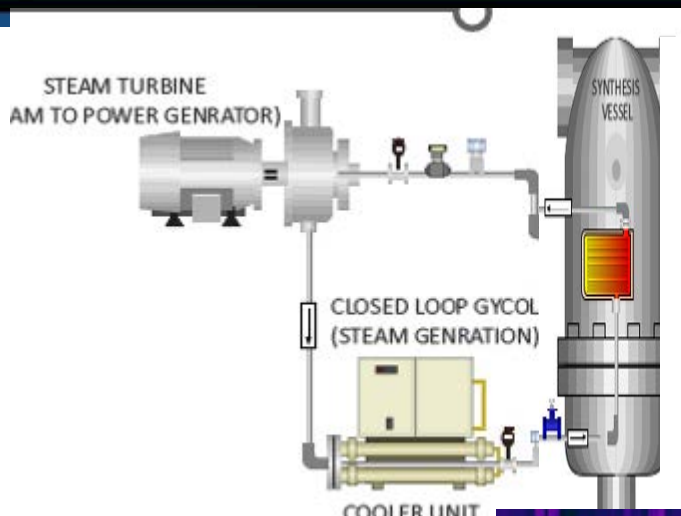
FT

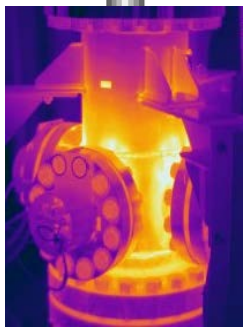
CPOX

Fischer Tropsch

Catalytic Partial Oxidation

Compression Conditioning (HDS)



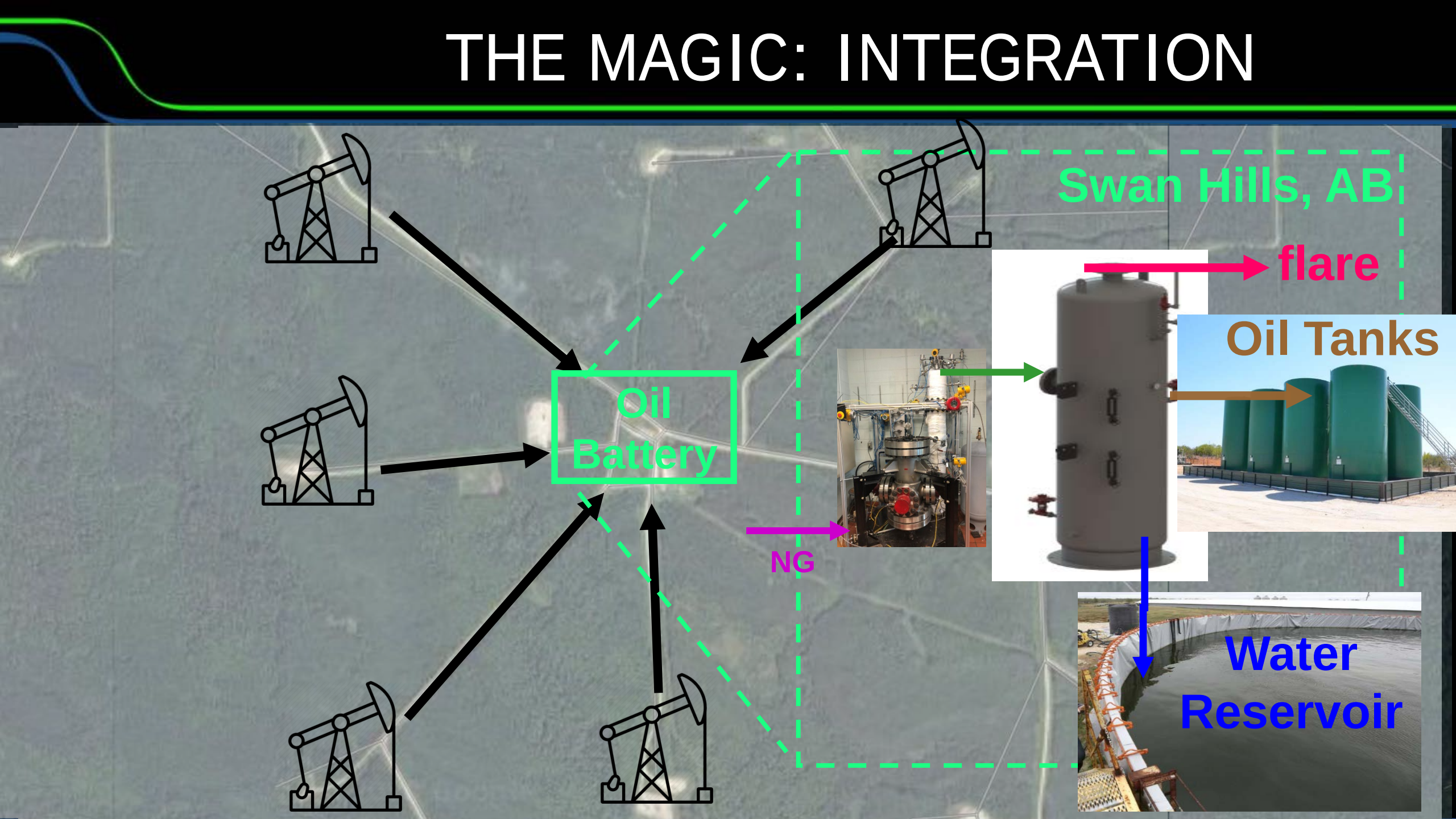


Jet fuel, Diesel

CO, H_2

CH_4 Air

THE MAGIC: INTEGRATION

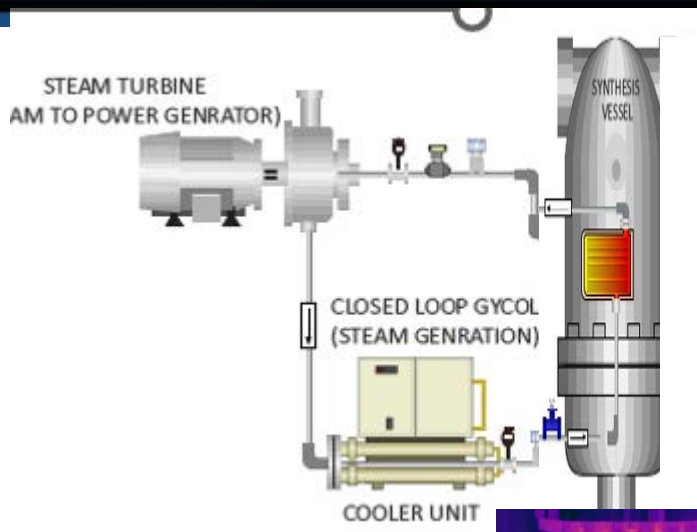


MORE MAGIC

Mass Manufacturing

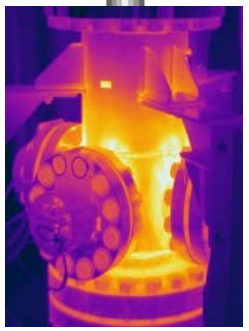
- 300 units/y
- $500k/unit
- Modular
- Mobile

Fischer Tropsch



Jet fuel, Diesel

Catalytic Partial Oxidation



CO, H_2

Compression Conditioning (HDS)

NG **Air**

THE MARKET

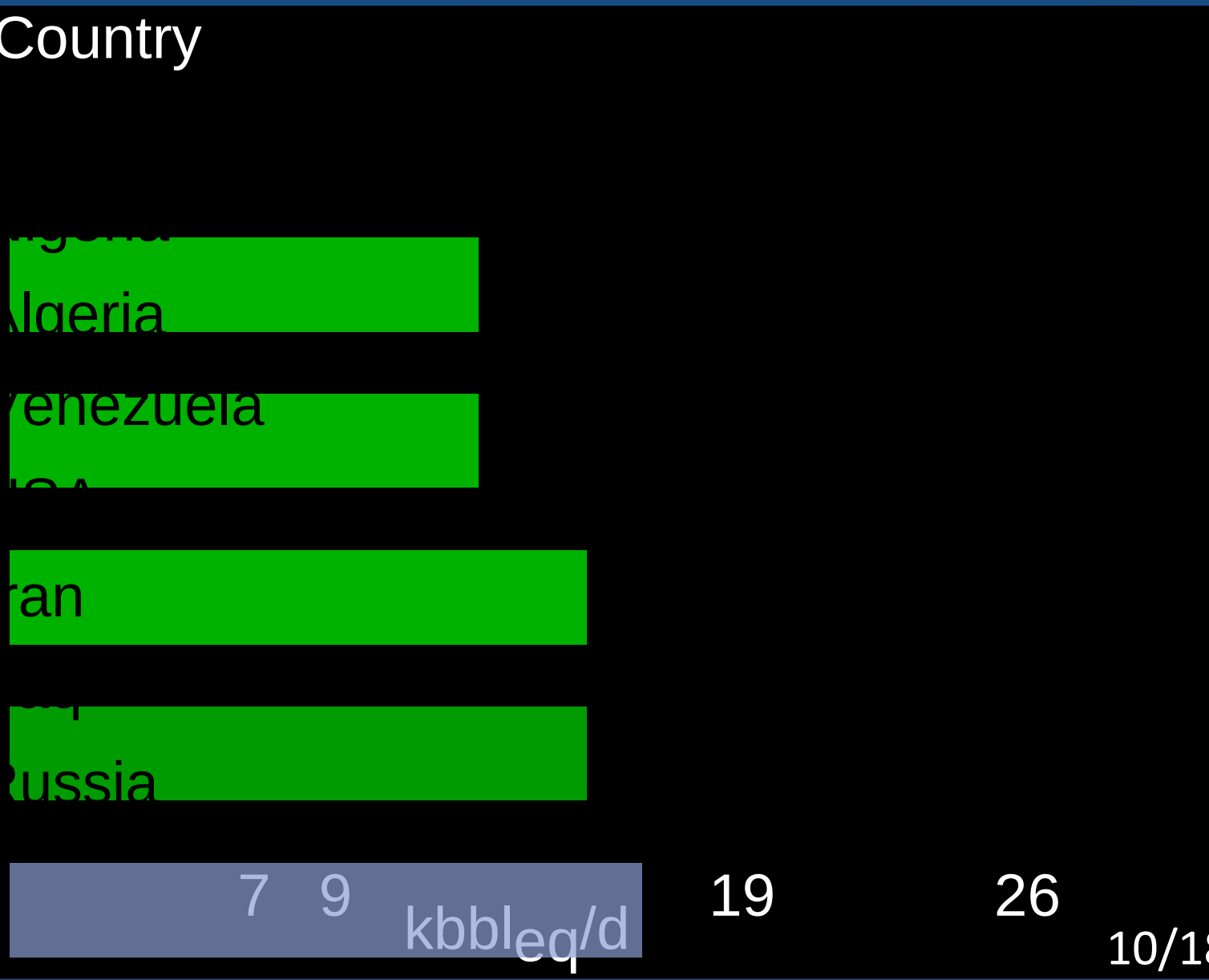
- Bakken (ND)
- Eagle Ford (TX)
- Shale gas

USA:

>$8.8 million/d

World:

>$150 million/d



THE ECONOMICS

Unit Basis

3 y net revenues	$800 000 ($80 bbl X 10 bbl/d X 330/d X 3)
3 y CO_2 offset	+ $200 000 ($50/t X 4 t/d X 330/d X 3)
Cost	– $500 000
3 y NPV	$500 000

CO_2 reduction — 1 kt/y/unit

Options — Sell to customers
Share production
Rent units

THE COMPETITION

Inelastic Price of Demand

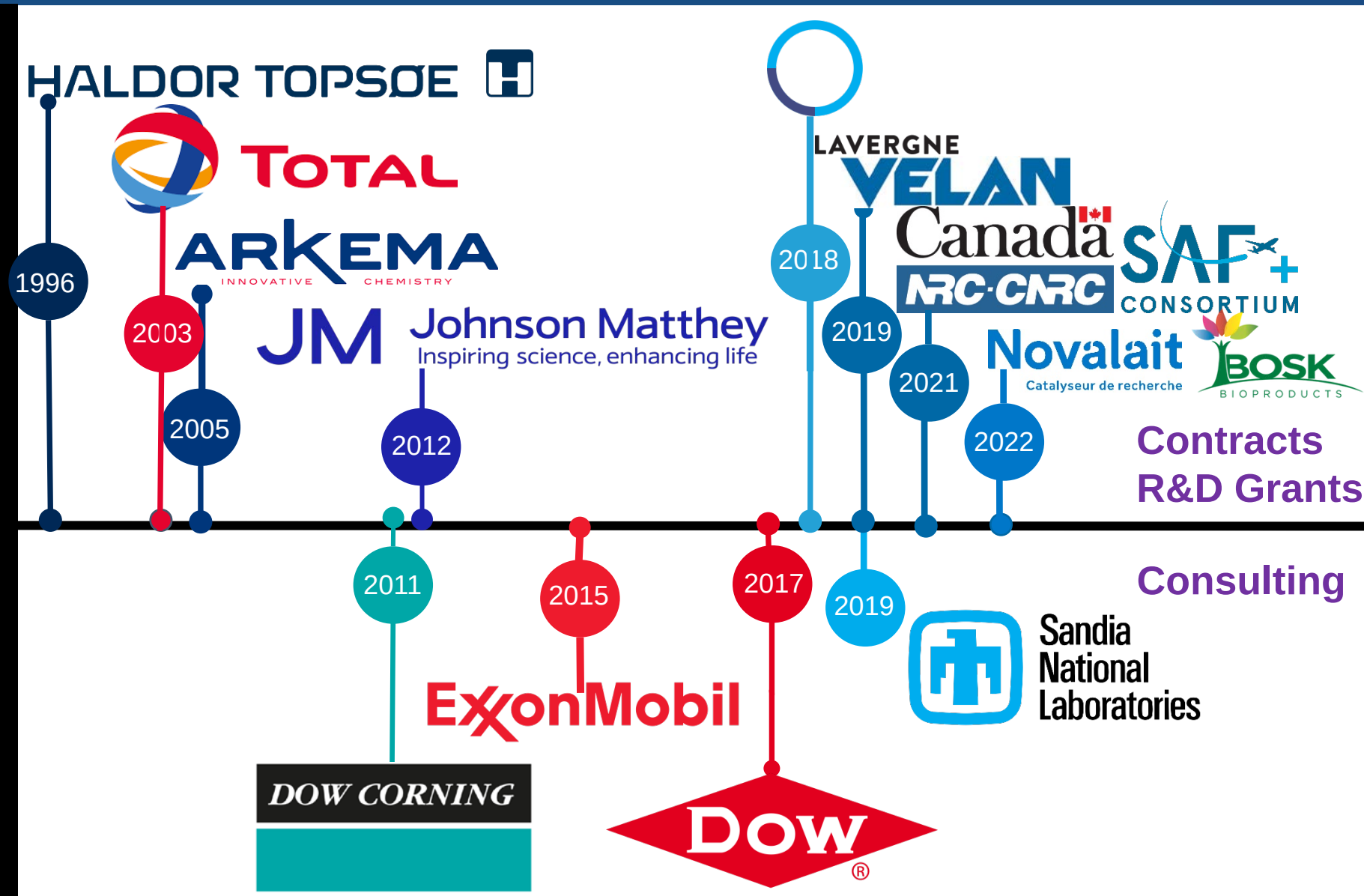
Market Potential

- Biogas
- Landfill gas
- Gas hydrates
- Shale gas
- Coal gas

Company	Small <100 bbl/d	Medium <1000 bbl/d	Large >1000 bbl/d

Legend target | possible | out of scope

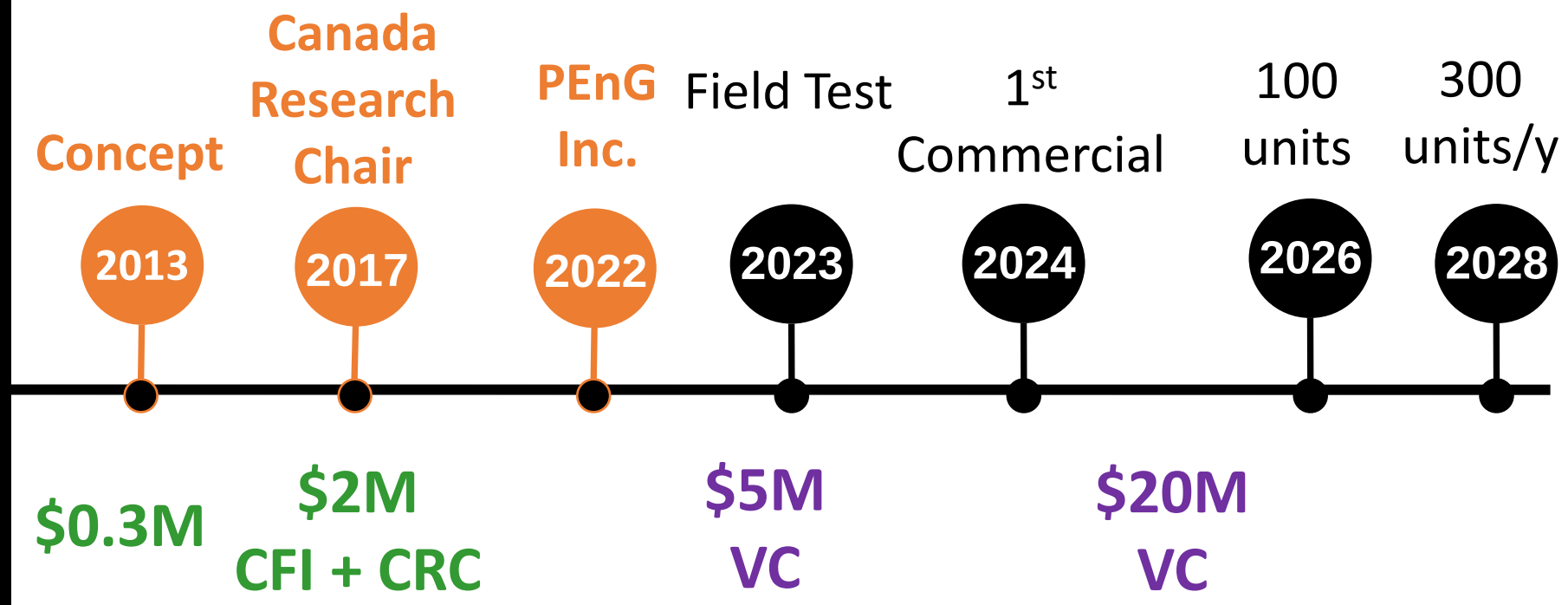
1983 BSc U of C
1984 Baker Oil Treating
1987 MSc U of C
1990 PhD Polytechnique
1996 DuPont, DE
2000 DuPont Iberia
2004 DuPont Int'l
2017 Canada Research Chair



THE PLAN

Milestones

Investment



SWOT

STRENGTHS
Lowest CAPEX/OPEX
Patent pending
Gov't financing

WEAKNESSES
Time to demonstrate
Buy-in from operators
Capital

OPPORTUNITY
Insatiable market
Payback 1.5 y
Landfill gas, bio-gas

THREATS
Copy
H_2, methanol
Price fluctuations

WASTED NATURAL GAS TO GREENER DIESEL

Technology	Micro refinery unit integration with oil battery
TRL 5	TRL 9 within 2 y, $5 million investment
Manufacturing	100 units within 5 y, $20 million investment
Market	>3000 units in NA (Alberta, Bakken, Texas)
Economics	Margin: $200 000/unit: $600 million in 10 y
Threats	Electricity, H_2, methanol, shutting in production