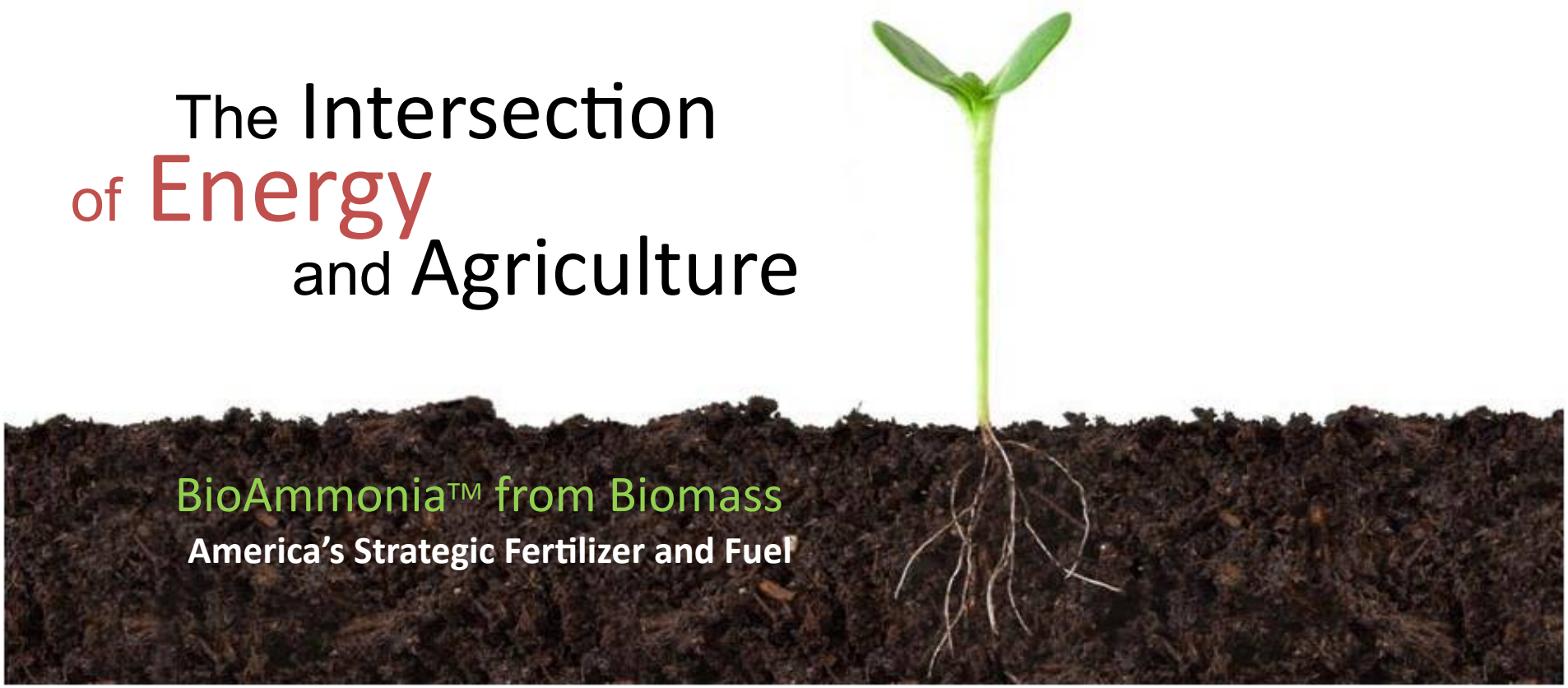
SynGest

The Intersection of Energy and Agriculture



BioAmmonia™ from Biomass

America's Strategic Fertilizer and Fuel

SynGest

Commercialization Of a Private R&D Lab

Cornucopia BioRefinery™

The Three F's:
Food, Fertilizer and Fuel™

Cornucopia BioRefinery™

“You can have your fuel and eat it too!”

SynGest "Project Cornucopia"

Where Energy and Agriculture Meet
The Three F's: Food, Fertilizer and Fuel

DRY FRACTIONATION

GERM

ENDOSPERM

BRAN

GRINDING

OPROTEX EXTRACTION TECHNOLOGY

FOOD GRADE CORN OIL

HIGH PROTEIN FEED

ENZYMATIC SACCHARIFICATION

FERMENTATION

DRY STILLAGE (Riboflavin Rich)

CO_2/H_2

EXTRACTIVE SEPARATION

Optinol

AIR

HARVEST GAS GASIFIER

AIR SEPARATION UNIT

WATER GAS SHIFT & PSA

N_2

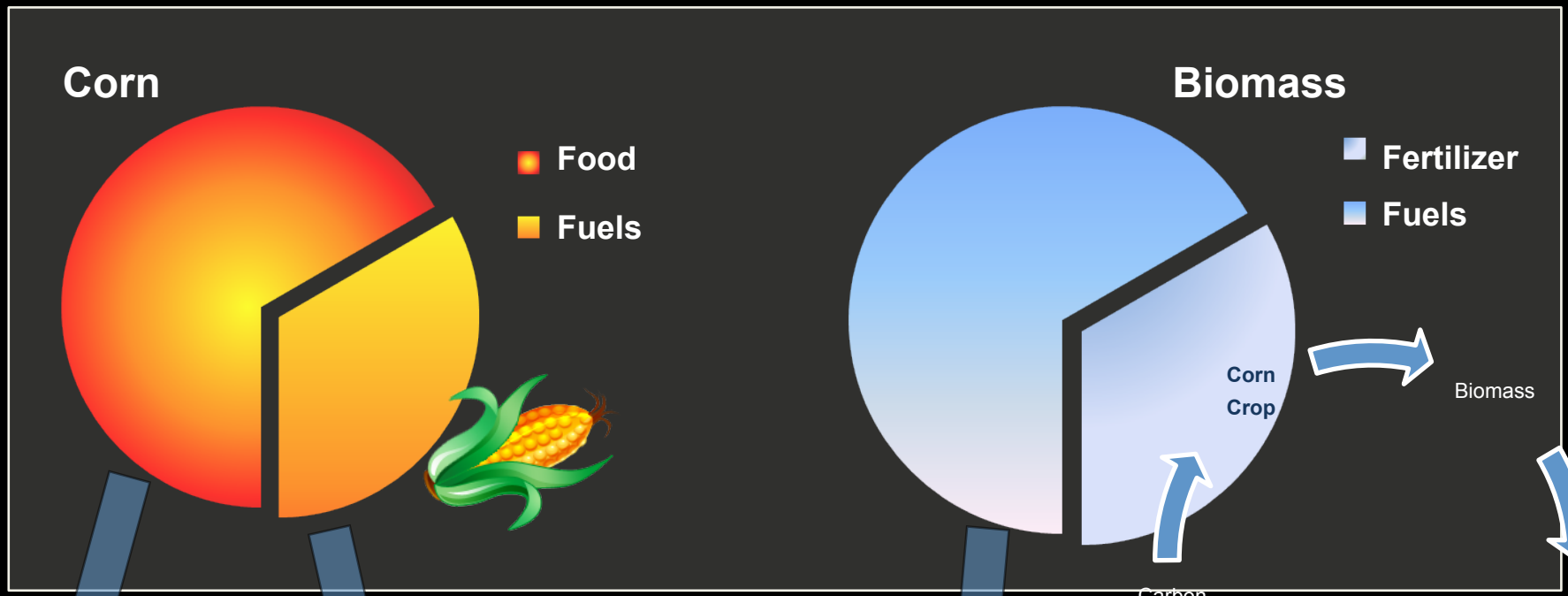
PURE H_2

NH_3 SYNTHESIS

ANHYDROUS AMMONIA FERTILIZER

Cornucopia BioRefinery Complex

Maximizing Food , Fertilizer and Fuel Production from Every Ear of Corn



Cornucopia Technology

Slipstream biomass harvesting

Dry milling – a.k.a. Fractionation

Fermentation

Gasification

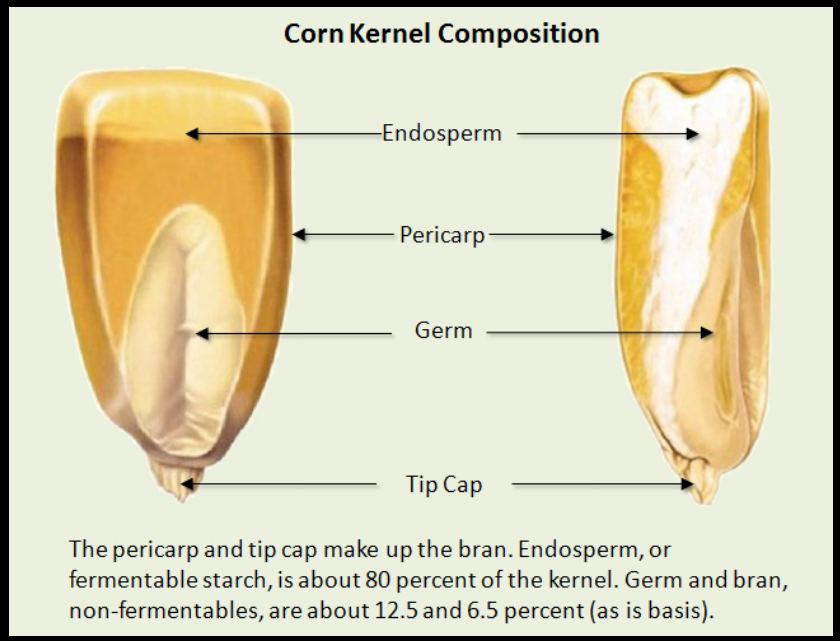
Food-grade oil extraction

Fractionation

Endosperm (starch) = **fermentation**

Germ = **food-grade vegetable oil / protein**

Bran and cobs (cellulose) = **gasification**



Fermentation

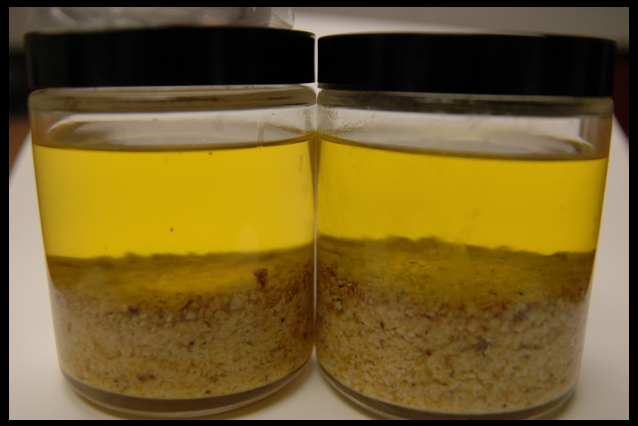
- Endosperm (starch) fermented into fuels
- Today = Ethanol
- Soon = BioButanol, Diesel, etc. a.k.a. “Drop-in”
- 20% increase in production from existing plants
- Lower cost per gallon
- Higher net energy
- Lower carbon content

SynGest Gasification

- Bran / cobs
- Carbon-negative NH_3
- Methanol, DME
- >50% less fossil energy/ carbon

Food-Grade Oil / Protein

- Low cost GRAS solvents
- Food-grade vegetable oil
- Food-grade protein (dry / de-oiled)
- Combined value greater than DDGS
- Maximum food value

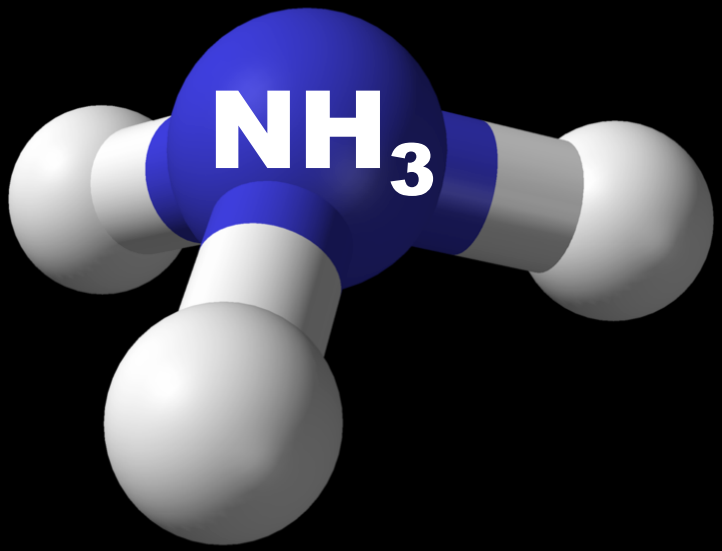


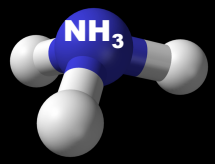
Anhydrous Ammonia

Fertilizer

NOx Reducer

Fuel





SynGest BioAmmonia™ Process

Core Technology

Biomass Feeder 130k TPY

FLUIDIZED BED GASIFIER

AUTOTHERMAL REFORMER | SYNGAS YIELD ENHANCEMENT

Syngas CO & H_2

HEAT RECOVERY | WATER GAS SHIFT | PRESSURE SWING ADSORPTION

AIR SEPARATION PLANT

O_2

H_2

NH_3

N_2

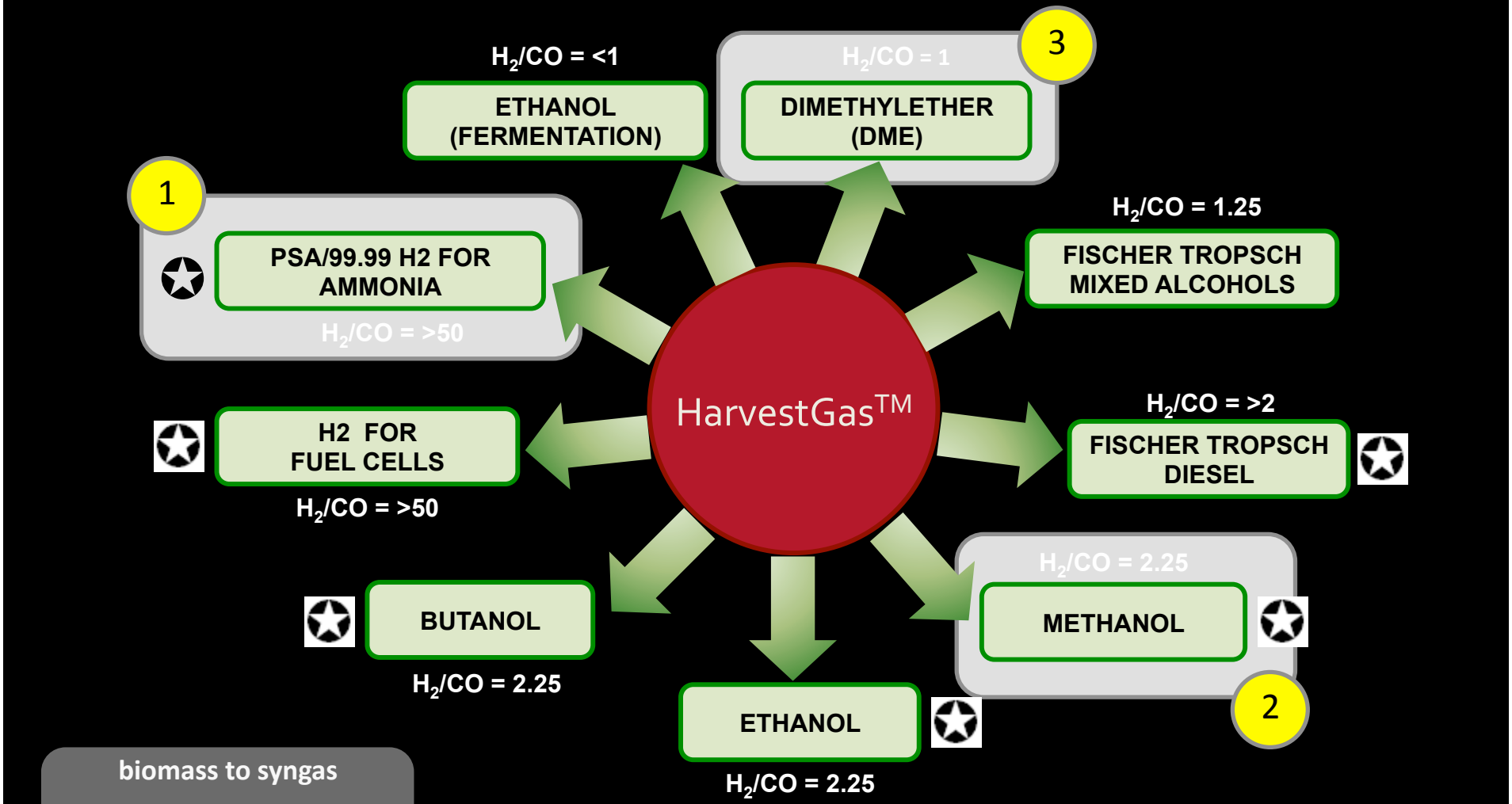
AMMONIA SYNTHESIS 50k TPY

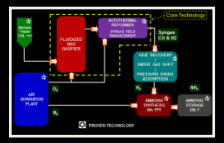
AMMONIA STORAGE 30k T

PROVEN TECHNOLOGY

CO H2

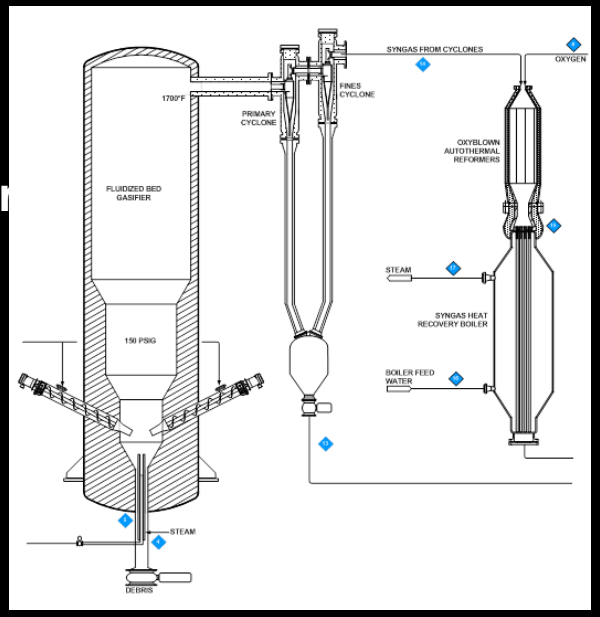
Syngas/BioSyngas Applications

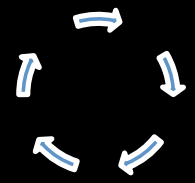




Core Technology Advantages

- Two step oxy-blown biomass gasification
  - Proprietary biomass oxygen gasification unit
  - Oxygen-enhanced auto-thermal catalytic refor
  - Guaranteed by Alion Science
- No “gas cleanup” required means …
  - Lower capital cost
  - Simpler operations
  - No toxic waste
- Energy self-sufficient
- Result = Lowest cost / highest yield production of syngas from biomass



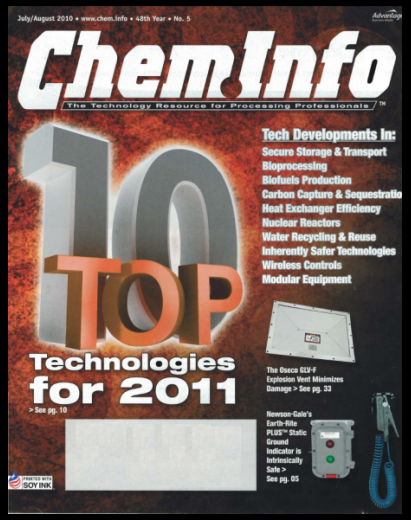


“Local In/Local Out” Business Model

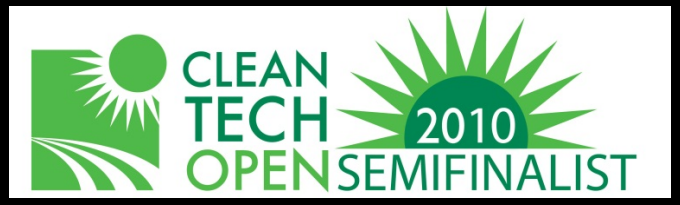
- “Local In”
  - Long term indexed supply contracts
  - Biomass feedstock sourced within 30 miles
  - Railroad ties /Corn stover and cobs / Miscanthus
- “Local Out”
  - Long term distribution via coop(s)
  - Fertilizer distributed within 50 miles
- Expansion opportunity includes “tolling” arrangements

Recent Team Recognition

- Chem.Info Magazine “Top 10 Technologies for 2011”



- Cleantech Open 2010 Semifinalist



SynGest Demo Project #1

- First Commercial Scale Demo
- $2.5 million grant Iowa Power Fund
- Menlo, IA (45 miles from Des Moines)
- Biomass Usage: 130,000 TPY
- Ammonia Production: 50,000 TPY
- Several feedstock opportunities
- Committed large offtake partner
- Adjacent to operating ethanol plant
- Near I-80, Rail access

How to get DOEs attention?

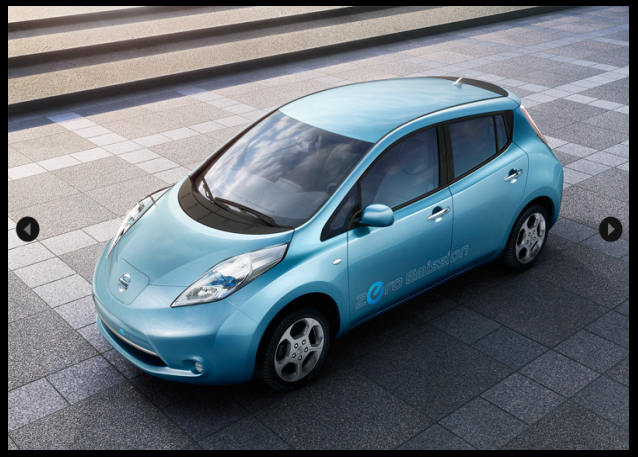
Change the name to
protect the innocent?

N-Hydrogen$_3$

The World's Next Energy Carrier

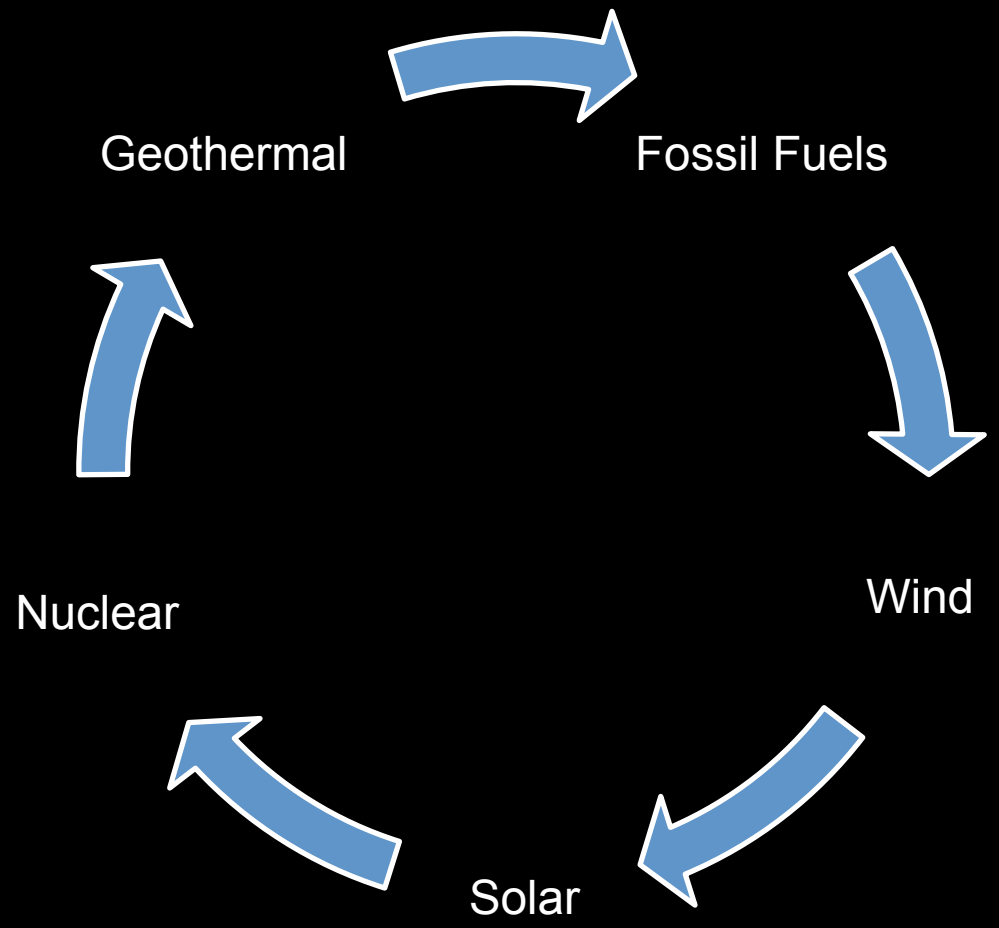
Jack Oswald

Nissan Leaf

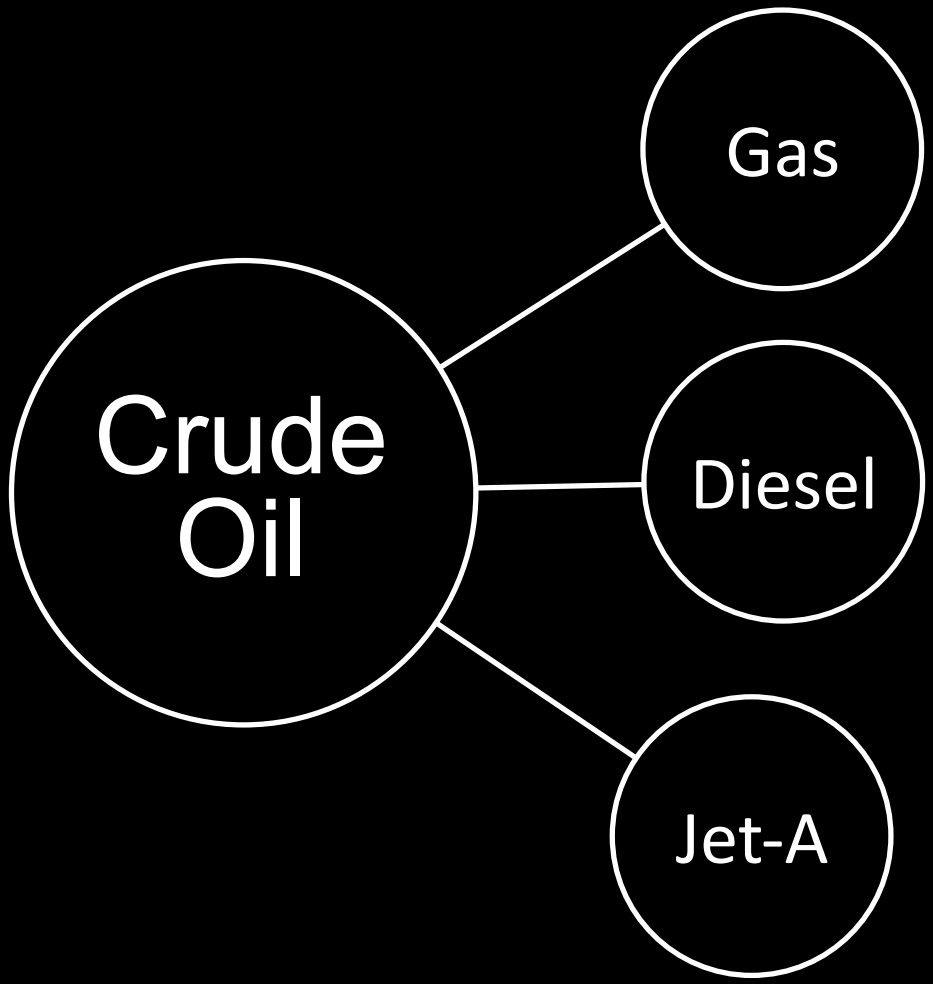


BMW Hydrogen 7

Electricity Marketplace



Petroleum Fractionation



Hydrogen

N-Hydrogen

$3H_2 = N_2 \; _3$

Liquid Fuel

Non-Flammable

Internal Combustion Engine (ICE)

Diesel Engine

N-Hydrogen$_3$ (150%) > H_2

Liquid Battery

Does Not Degrade

Fertilizer

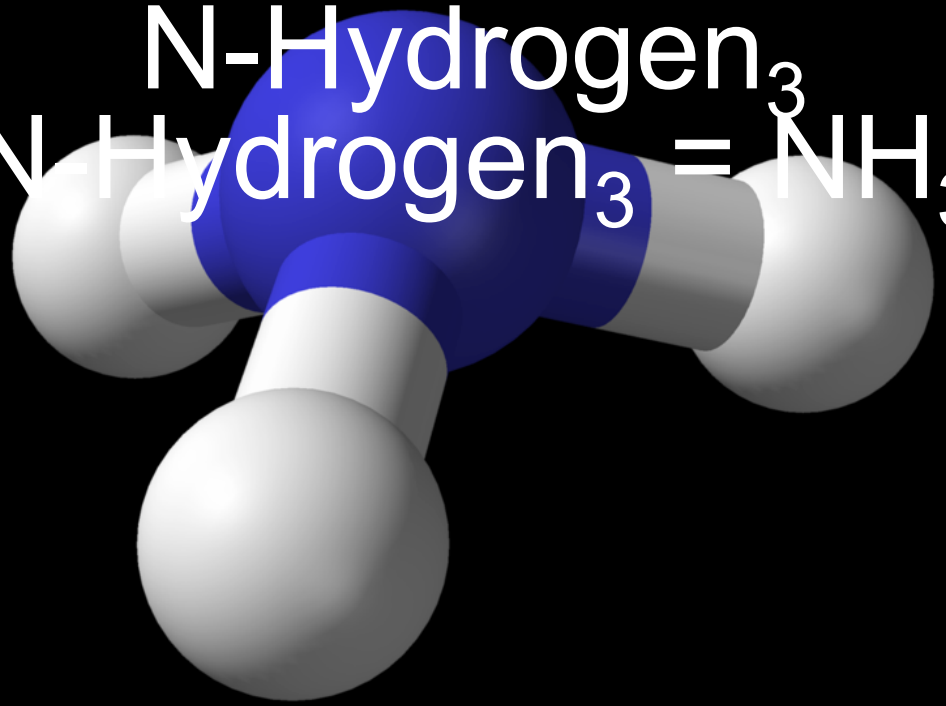
Refrigerant

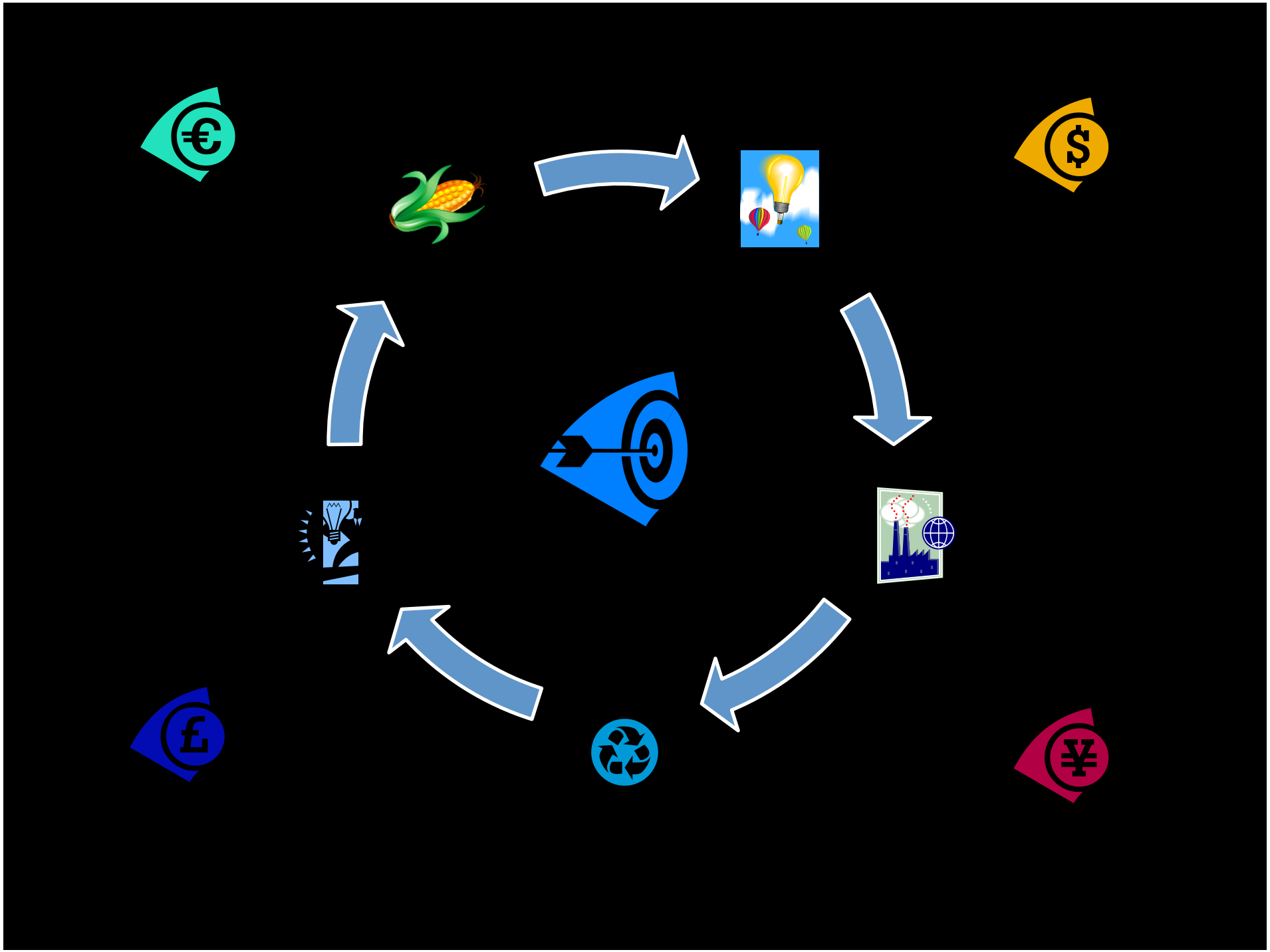
N-Hydrogen$_3$

Anhydrous Ammonia

N-Hydrogen$_3$

N-Hydrogen$_3$ = NH_3





Production Methods

Raw Materials

Electricity

Air

Water

Chemical Conversion

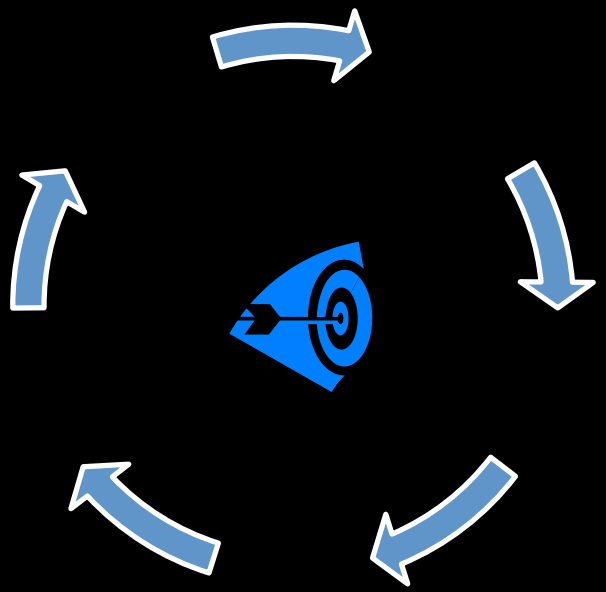
Wind

Solar

Nucular

Coal

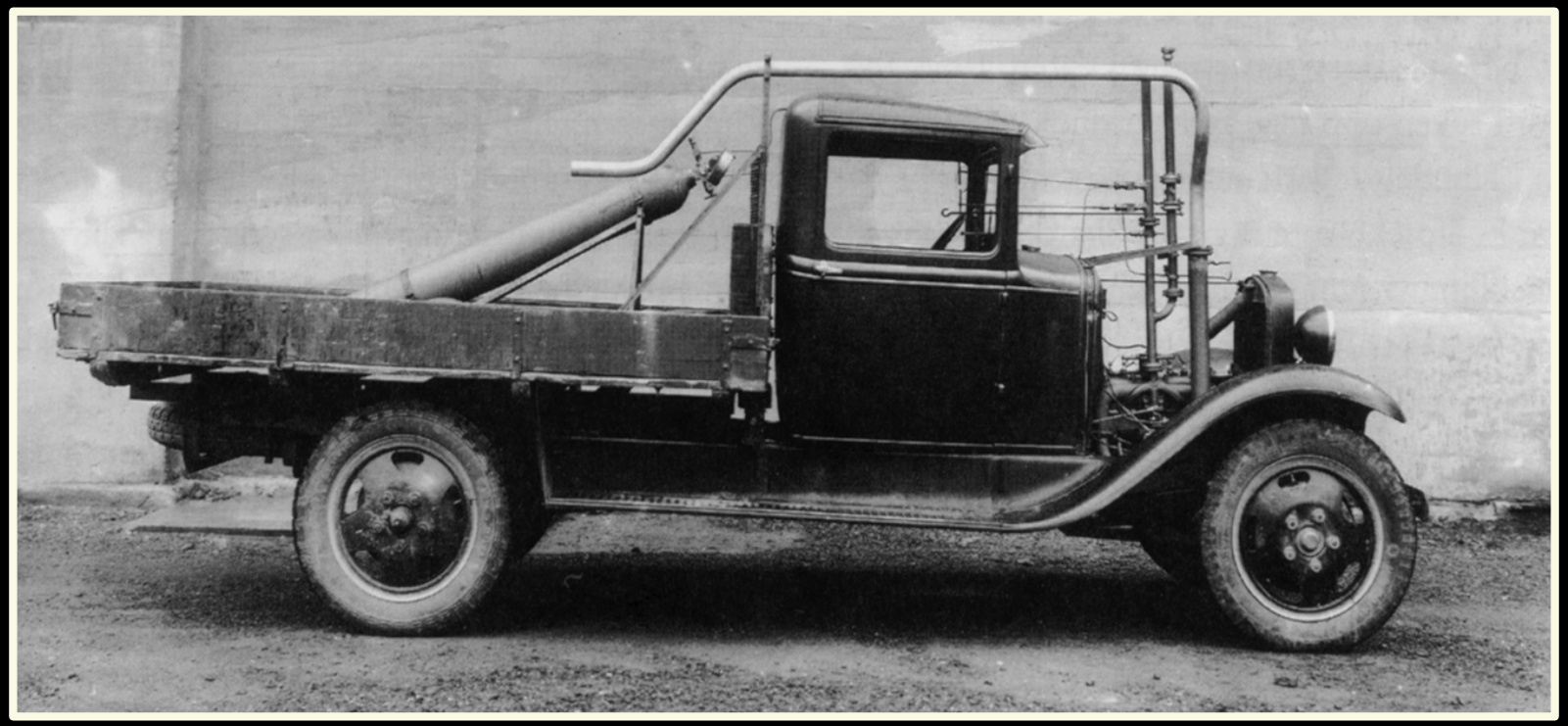
The Power of Markets



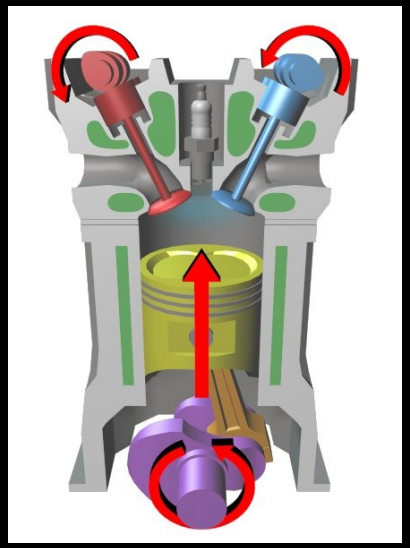
NH_3

Production

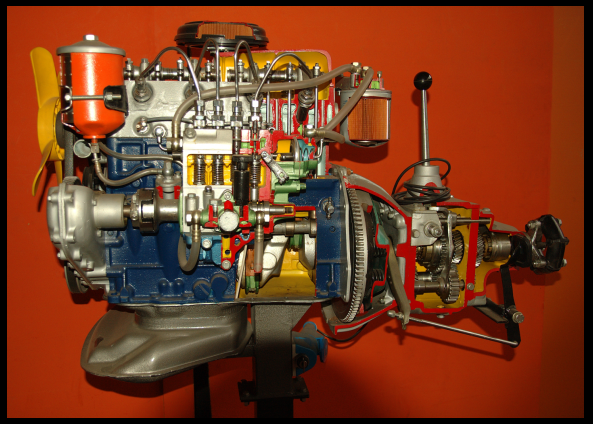
Ammonia Fueled Vehicle – Rjukan 1933



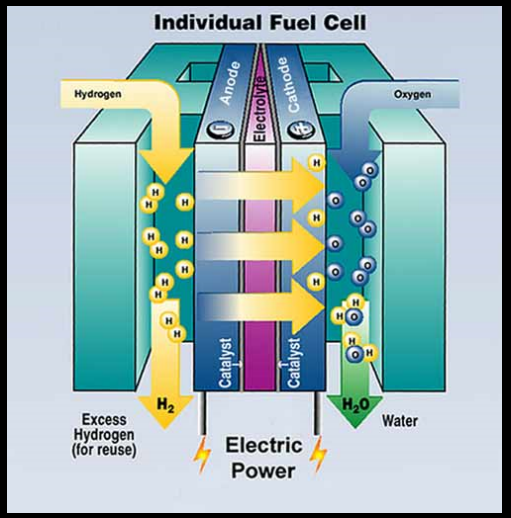
ICE



Diesel



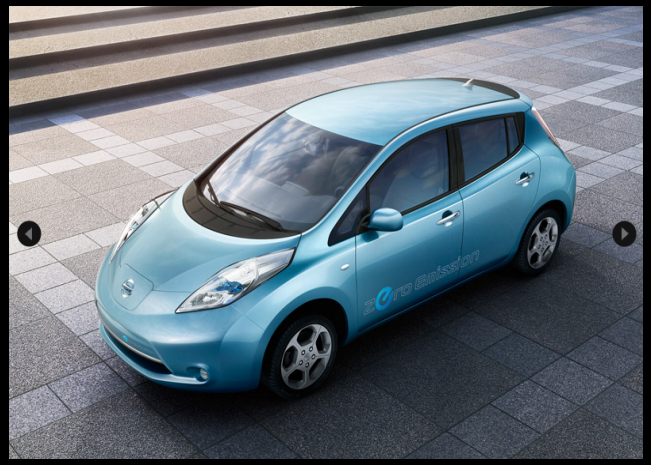
Fuel Cell



Tesla Roadster

Tesla Model S

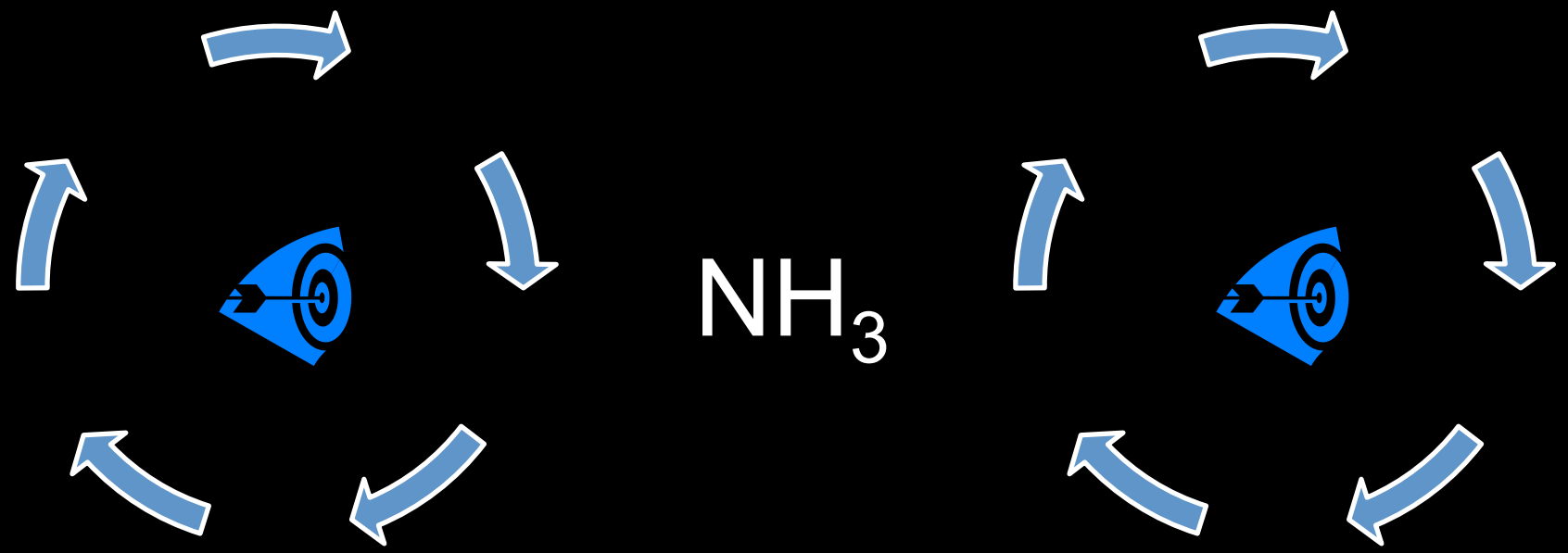
Nissan Leaf



Which will win?

?

The Power of Markets



Production

Usage

Existing Infrastructure

U.S. Pipeline Network

3000 Miles

Storage / Distribution

N-Hydrogen3 (NH3)

Ammonia STORY

To Energy Independence And Beyond

Thank you