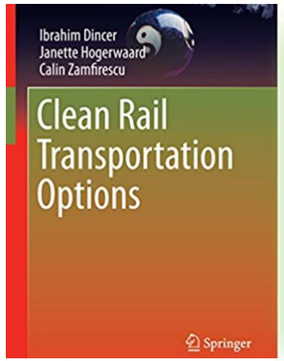
NH_3 TRANSPORTATION

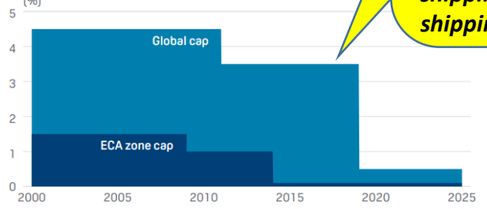


Ammonia as a Sustainable Transportation Fuel.

- High octane rating of NH3 (110-130) for ICE applications
- Global production and distribution infrastructure developed over 100 years ★★
- Can be thermally cracked for H2 and exhaust heat recovery
- NH3 is safer than other fuels due to high rate of dissipation in air, strong (self-alarming) odor at very low concentration (~ 5 ppm in air), and is considered nonexplosive due to its very narrow flammability range.

Professor Ibrahim Dincer (UOIT) is one of the world's leading experts on sustainability, systems analysis, ammonia as an energy vector and machine design ★

Shipping industry must displace a large fraction of high S bunker fuel by 2020. Large growth of ammonia shipping could facilitate ammonia engines for ammonia shipping. And additional shipping. ★

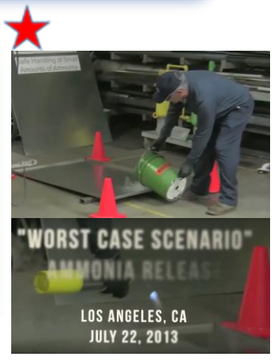


Greg Vezina has a 35 year history building and developing ammonia cars ★

NH_3 REFRIGERATION

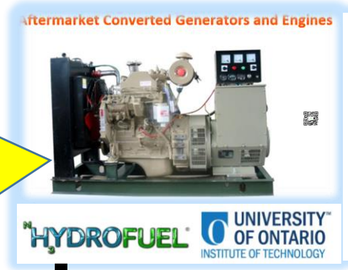
★ Ammonia Refrigerant

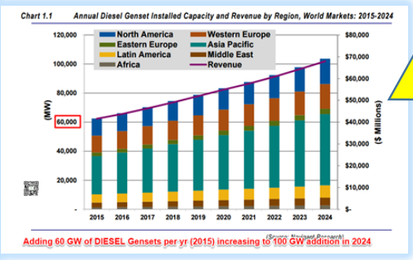
- Systems cost 10-20% less to build than CFC systems
- Ammonia is 3-10% more efficient than CFCs, saves power.
- Ammonia has an Ozone Depletion Potential (ODP) rating of 0 and a Global Warming Potential (GWP) rating of 0.
- Ammonia is substantially less expensive than HCFCs



NH_3 POWER

Hydrofuel® will convert diesel gensets to zero carbon ammonia gensets. (Also no SOX, soot and PM). ★

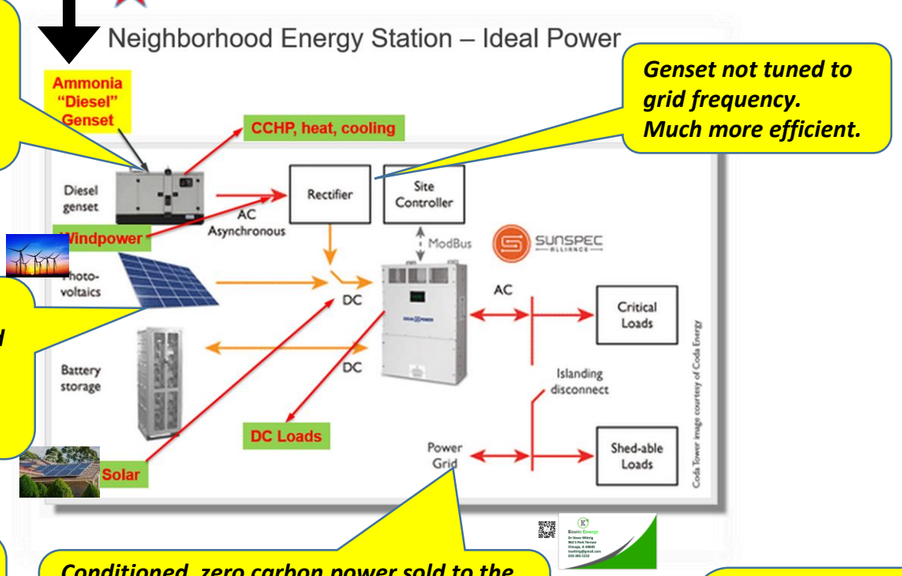




At least 60 GW of diesel genset capacity added every year (equivalent to 60 large nuclear reactors or the output of about 60 world scale ammonia plants. ★

★

Zero carbon power provided immediately when sun/wind slows or demand is high.

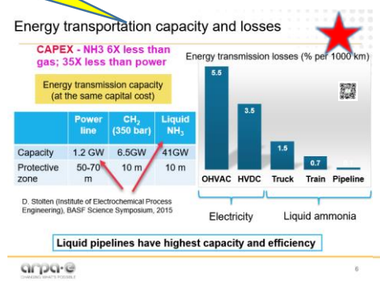


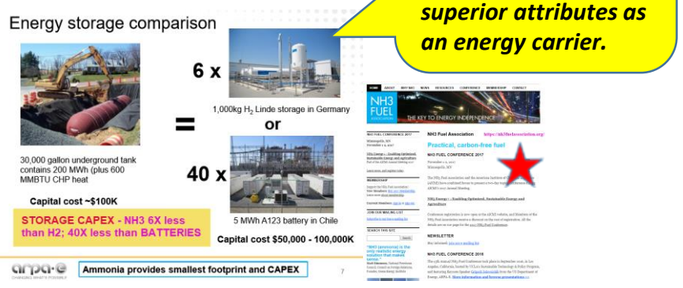
Genset not tuned to grid frequency. Much more efficient.

Efficient conversion of DC & unregulated AC power to conditioned power for the grid.

Much cheaper and safer energy storage than batteries or hydrogen

Conditioned, zero carbon power sold to the grid when profitable. Ancillary value - 5 min ramp, voltage/frequency support, black start, 3+ days supply.





DOE/ARPA-E is beginning work with NH3 Fuel Association based on ammonia's superior attributes as an energy carrier.

CTRL-CLICK ★'s FOR MORE INFO

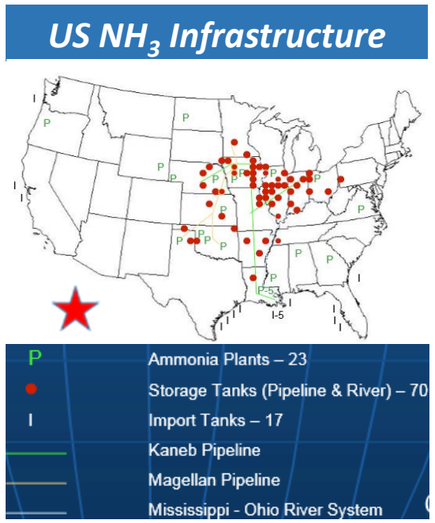
WAKE UP TO THE NH_3 ECONOMY

NH_3 IS VERY COST COMPETITIVE.
Diesel @$2.50 gal - $20/mmbtu LHV
NH_3 @$300/tonne - $16/mmbtu LHV

CONTACTS:
gvezina@nh3fuel.com
tswittrig@gmail.com

Ammonia (NH_3):

- Is the second largest synthesized industrial chemical in the world.
- Contains about 48% more hydrogen by volume than liquid H_2.
- Does not emit CO2, SOX, PM during utilization (cars, powergen)
- Can be stored and transported under relatively low pressures.
- Can be produced from varied resources from coal to renewables.
- Can utilize steel pipelines (e.g., oil, gas) with minor modifications.
- Incomparably flexible fuel (engines, turbines, boilers, fuel cells)
- Enables distributed power generation and smart grid applications.
- Is a non-GHG refrigerant (auto AC, refrigerated transport)



PIPELINE

RAIL

OCEAN
RIVERWAYS

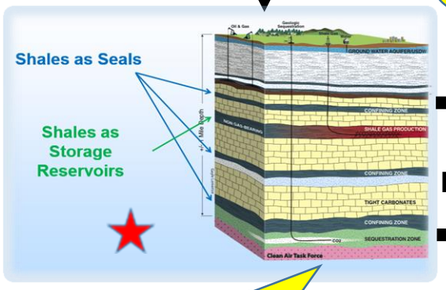
ROAD

NH_3

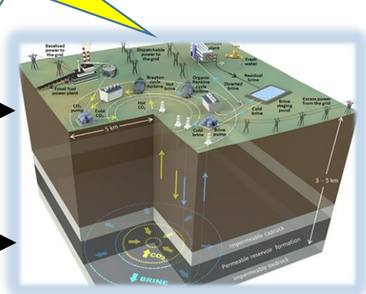
CO_2

Gas to NH_3 ~$200/T

Storage of CO2 in deep reservoirs to store utility scale power and produce geothermal energy.

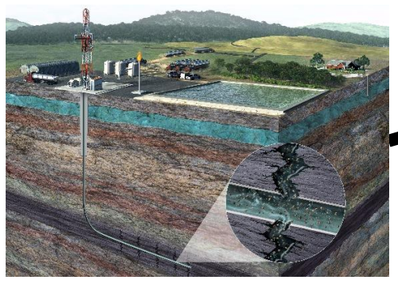


EARTH BATTERY



ENHANCED OIL/GAS RECOVERY

Sequestration in empty gas reservoirs or saline aquifers

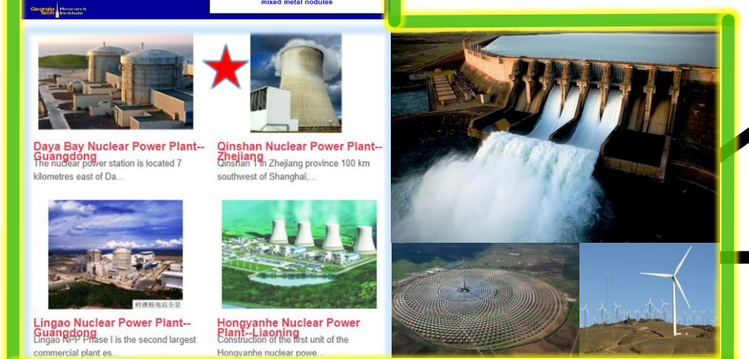


GAS

e^-

H_2

HVDC



e^-

H_2

LOCAL ammonia for regional use and clean energy

CTRL-CLICK ★'s FOR MORE INFO