Wave Liquefaction™ process

combines *gaseous* and *solid* hydrocarbons to cleanly and efficiently produce *liquid* fuels, chemicals, and value-added carbon products.

Originally developed with DARPA funding at a DOE national lab for production of military jet fuels from coal, now commercialized for a wide range of applications.

Key advantages:

- virtually zero CO$_2$ emissions or process water consumption
- low capital ($15K per bpd) and production (<$30/barrel) costs
- high feedstock flexibility (10+ coals and coal/biomass blend tested)

**H Quest holds an exclusive world-wide license to this breakthrough technology and is seeking strategic investors and partners for commercialization and scale-up.**

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Wave Liquefaction™ Products

Liquid product: Fuels or Chemicals (yields of 50%-65% wt)
Process is highly flexible and tunable
- Product Hydrogen:Carbon ratio can vary from 1 to 1.51
- Can achieve low aromaticity (< 50%) for fuels and crude oil
- Can achieve high aromaticity (90%) for chemicals and coal tar

Coal tar applications include:
- Carbon pitch for anodes for aluminum smelting:
- Creosote for wood preservation (railroad ties, telegraph poles)
- Naphthalene and other chemicals and precursors

Solid char byproduct (yields of 30%-50% wt).
Key characteristics:
- Reduced sulfur and moisture content
- High porosity and surface area (based on microscopy)
- High electric conductivity
- High fixed carbon content

Potential uses and applications:
- Activated carbon feedstock
- Application in blast/electric furnaces (e.g. PCI, EAF)
- Gasification feedstock
Commercialization Strategy Overview

Original target: Coal to Fuels
Technology developed for production of BTEX and refinable synthetic oil from lower-cost thermal coals

Hurdles:
- High pre-ROI investment requirements (> $100M)
- Long path to commercialization (5-10 years)
- Refinery integration/acceptance

Springboard to commercialization: coal to chemicals
- Smaller market ($200M-$400M/year) with persistent shortage of aromatic liquids (coal tar): 5 very motivated customers
- Short path to commercialization: 2 years, $15M to a demonstration plant ($1M/year EBITDA)
- Engaging with major coal tar distiller
- Additional upside from high-value char by-product ($120+/ton)
Commercialization strategy details

North American coal tar market summary:
- At least >39 million gallons/year (> 2500 barrels/day)
- Coal tar imports are limited and do not cover idle capacities
- Deficit of coal tar is growing due to coke plants idling or shutting down

2015 coke production disruptions
- U S Steel announced plans to shutter Granite City, IL and Gary, IN coke plants
- ArcellorMittal idled a coke battery in Hamilton, ON in March 2015

Staged deployment:
200 barrel/day (100 tons of coal/day) coal tar pilot plant
- Plant EBITDA: $1.1M / year
- CAPEX: $10.5M equipment + $4.5M construction and engineering
- Deployable in 2 years; brownfield would ease deployment
- Future expansion to 1000+ barrel/day (500+ ton/day)
- Pursue DOE assistance / government loan guarantees

500 barrel/day (1000 tons of coal/day) coal tar plant
- Expansion of the pilot, leveraging siting, permitting and engineering
- Estimated cost including pilot engineering and deployment: $50M
- Plant EBITDA: $11M per year

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