

A futuristic, metallic robotic arm is shown in a close-up, angled view. The arm is dark blue or black with some lighter blue accents. A large, complex gear is attached to the end of the arm. The gear has a central hub with several circular openings and a serrated outer edge. The background is a soft, out-of-focus teal or light blue gradient.

*thoughtality.com*

# Twin Technologies

for the Electric Transportation & Renewable Energy Era

INVESTMENT OPPORTUNITY

# Twin Technologies

FOR THE OPEN GLOBAL MARKET

## GROUND BREAKING NEW ICE, ELECTRIC GENERATING SET & SYNCHRONOUS MOTOR

- ➔ No Gearboxes
- ➔ Superb efficiency
- ➔ Exceptionally compact
- ➔ Light-weight
- ➔ Direct Coupling with no vibration



# Twin Technologies

## TWO-PHASE MOTORS

### SUPERIOR GRAVIMETRIC AND VOLUMETRIC POWER DENSITIES

#### EFFICIENCY



On par with high-end 3-phase sinusoidally driven motors but simpler in topology and power electronics. The 2-phase winding is simple with minimum number of armature coils and little or no end-winding waste. This translates to lower manufacturing costs than other motors.

In one embodiment the armature topology allows for extremely efficient cooling.

#### TORQUE



It has superior torque quality as compared to BLDC (Brushless DC Motors) motors with minimal or no ripple. Also comparable to high-end 3-phase motors.

#### ECONOMY



The unique drive waveform has a simple algorithm for real-time processor computation. This means more reliable, cheaper power-electronics with less parts count.

ready for prototyping

# Twin Technologies

**TORC\* I.C.E. (Internal Combustion Engine)**

\* Acronym for twin technology



## A low part count, valve-less I.C.E.

- ➡ There are no valves, cams or gears; only ports.
- ➡ Two-stroke cycle with full scavenging and easily supercharged due to favourable inlet/exhaust port overlap (not possible with existing ported 2-stroke engines). Self supercharging (no blower or turbo required). Exceptional efficiency.
- ➡ Diesel or petrol. This engine will run on a range of fuels including kerosene, petrol, hydrogen and bio-fuels.
- ➡ There are no harmonics. The engine is intrinsically balanced with zero vibrations. There are as many power strokes as there are cylinders – equally phased during one revolution. Any number of cylinders is possible using multiple co-axial stages.
- ➡ Extreme high power density. This engine is small in size and weight for its power and can be comparable to that of a turbine.
- ➡ Low part count. There are 8 moving parts (in a 3-cylinder configuration). This engine uses cylinders, pistons and piston rings – proven technology.

# ICE - TORC

OPPORTUNITY FOR INVESTOR TO PARTICIPATE IN THE IP

## The TORC\* Engine

- Versatile fuel sources- petrol, diesel, bio-ethanols, methane, hydrogen
- Multiple heat cycles within a two-stroke architecture
- Suitable from micro to ultra-large shaft outputs 5kW - 5MW with constant torque

## The next generation of E-Mobility

- Smaller than comparable volume conventional ICE
- Lighter
- And far Simpler yet still uses standard cylinders

## Ground-breaking Engine

- When coupled to the Two-phase Alternator: Greener, Smoother, Cheaper, and Cooler exhaust than all existing engines designs



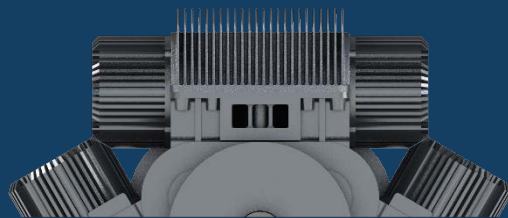
# Where?

- The TORC engine enables e-mobility efficiency when batteries or fuel cells have inadequate kJ/Kg output. It achieves range without crippling mass or cost.
  - Flight extension for drones, light electrically powered aircraft 10-275kW
  - Super efficient range extender for hybrid electric cars 20-50kW
  - Exceptionally efficient two wheelers power source for touring 5kW
  - Constant generator for heavy trucks 50-275 kW
  - Locomotive gen-set using hydrogen and oxygen electrolyzed from water 2MW
  - Ship propulsion alternative to more expensive fuel cells 5-15MW
  - A multi-stage TORC engine could be more cost-effective and fuel efficient than a turbine using the same fuel, easier to maintain and slower revving.



# Twin Technology

## BENEFITS



### IC ENGINE\*

- No valves, gears, belts or pulleys.
- Proven Piston & Cylinder Technology
- 2-Two stroke cycle
- Diesel, petrol, or hydrogen
- Zero vibration
- Extremely high power density.
- Low part count - 8 moving parts per stage



### MOTOR / ALTERNATOR

- Super-Efficiency
- High-End Performance for PWM controlled motors
- The Alternator version produces both AC and rectified DC current. The DC current is high quality and ripple free.
- Compactness
- Low Production Cost

# SIMPLER - LIGHTER - SMALLER

## FAR SIMPLER

- A two stroke design using ports with excellent scavenging & supercharging overlap
- Just 8 moving parts in a 3 cylinder radial configuration
- Air-cooled unless very high performance is required
- No complex cast for the engine block

## LIGHTER

- Outer casing and pistons from aluminium castings
- Key internal moving parts from magnesium if required
- Very short crankshaft has two main bearings only
- Very light -balance and no fly-wheel required only counter balance.

## SMALLER

- Overall external size greatly reduced
- Can be designed in conjunction with alternator to be of similar diameter creating a highly compact gen-set.







# Greener - Smoother - Cheaper - Cooler

## GREENER

- Excellent breathing and scavenging will minimise unburnt fuel
- No oil added to fuel like conventional two-strokes
- Constant output power will optimise the fuel efficiency
- Less material used to make an engine

## SMOOTHER

- Centre of mass does not change when rotating
- Essentially zero vibrations are generated
- Three power strokes per revolution per stage
- Exceptionally smooth torque when combined with alternator

## CHEAPER

- Substantially fewer parts to manufacture( ~90% fewer)
- Less material and less machining.
- Super-charger is included in the standard design.
- A very powerful engine can be readily assembled using multi-stages on the same crankshaft.

## COOLER

- For larger units Brayton cycle ( with external combustion) may be utilised in a multi-stage configuration to extract more efficiency from the same fuel leaving a cooler, quieter exhaust gas.

Efficiency ~ 50%

# The Future

INTERNAL HEAT ENGINE

## The ultimate combination for baseload renewable energy

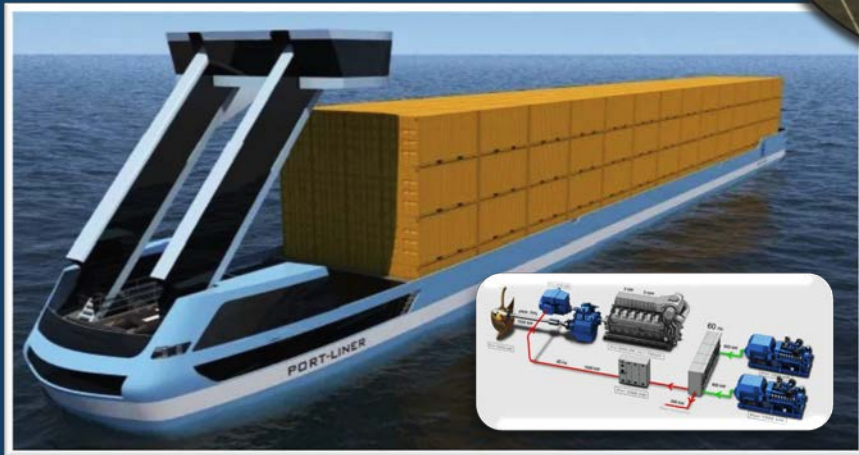
- The TORC engine can run as a Brayton Cycle motor with multiple expansion stages.
- This has the potential to reach exceptional efficiency of over 50%

# The Range Extender

*\*Possible Unit Name*

Engine and Generator may be coupled together for battery charging thereby extending the range of electric mobility in platforms such as:

- Commercial & private road vehicles
- Floating vessels
- Aircraft
- Drones and ROV's (Remote operated vehicles)
- Submersible and amphibious craft



*Possible Applications*

# PATENTS PENDING\*

## A new class of two-phase generation and low-cost hybrid drive systems

This engine/motor/alternator needs to be prototyped as several different versions to target specifications for evaluation in terms of performance as well as mission profile in actual applications such as vehicles, aircraft, etc.

This technology is **simple** and therefore prototyping this unit can be done quite rapidly.



# INVESTMENT OPPORTUNITY

There is an open global market for these units.

This technology is for sale and alternative proposals will be considered.



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