ELECTRICITY SERVICES FOR EAST MALAYSIA
October 2014
Steady and powerful ocean currents have long been recognized as a valuable source of renewable energy.
The C2C UPG design meets the challenge of generating base load power - safely and efficiently – from ocean currents.

Design Features

- Deep water operation (75-200 meters) below the first plankton layer.
- Low impact mooring system.
- Use of proven technology for most components.
- Unmanned submarine design for each 10 MW turbine.
- Submarine contains generators, impeller, bezel, and toroidal drive.
- Remote operation capable of maneuvering UPG in three dimensions.
- UPG produces AC or DC current for transmission to shore.
- Protected and low RPM impeller.

Underwater Power Generator ("UPG")

The UPG is a 10 MW Electrical Power Plant.
With the UPG, C2C can efficiently generate low cost, renewable, 24/7 electricity.

Benefits of the UPG

- C2C can generate **large amounts of power** with relatively few units.
- C2C can **generate significant power in slow in ocean currents**.
- Other gearing technologies do not offer the efficiency of the Toroidal Drive requiring competitors to deploy much larger and more complex structures to generate an equal amount of power.
- C2C has a **significant installation and maintenance cost advantage**.
- UPG is capable of **quiet operation that is safe to marine life**.
- UPG has **low maintenance costs due minimal heat emission** from the Toroidal Drive.

**Underwater Power Generator (“UPG”)**

The UPG is a 10 MW Electrical Power Plant.
Interest in wind, solar, and other renewable technologies has surged in the past five years.

- Wind and solar cannot be relied upon to meet electricity demand 24/7 (base load power) or to respond quickly to peak demand, disqualifying them for premium pricing.

- Wind and solar require huge footprints which generate relatively small increments of power per square foot
  - Solar requires 7 acres of solar panels to produce 1 mw of power
  - A 100 mw wind farm requires 2500 acres

- Wind installations face extraordinary permitting delays and growing NIMBY opposition.

- Wind turbines have costly maintenance and repair problems.

- Kyoto greenhouse gas (“GHG”) credits reached a price of $25-30 per ton of CO2 equivalent in Europe.
Traditional alternatives to fossil fuels for electricity generation are limited.

- No new nuclear plants have been commissioned in the U.S. since the mid 1970s. Efforts to restart a U.S. nuclear plant program are 7-10 years away from producing a single kilowatt hour ("kWh")

- Large hydro and geothermal resources are already largely developed.

- Hydrogen/fuel cell technology will be most useful for transportation rather than electricity generation.

- Wind and solar now account for only 2% of world electricity supply (2.8% in the U.S.).

- Both are still heavily dependent on unpredictable production tax credits and other subsidies to be profitable.
The proprietary Toroidal Drive replaces conventional gearboxes and is the key to economically harnessing ocean kinetic energy.

**Competitive Advantage**

- The Toroidal Drive allows for the efficient transfer of 98%* of ocean kinetic energy as compared to less than 50% for the best competitors.
- The drive functions by engaging gear sleeves almost all the time thereby distributing load.
- The drive is quiet because the gears remain engaged and there are no “clicking teeth”
- The drive is 10 times smaller in size and weight than a conventional gearbox.

“The Toroidal Drive is the most important development in gearing technology in the past 50 years . . .” wind turbine expert Charles Bird.

• Mr. Scott Fraser
When presented with Dr. Kuehnle's vision, a conceptual model of a 10 MW Underwater Power Generator was designed and built to illustrate the unlimited potential of ocean currents.
The UPG Prototype Demonstrator
The nacelle was designed with numerous sensors for evaluation of concept and design.
The UPG Prototype Demonstrator

Complete system was successfully tested at ALDEN Research Laboratories

Full proof of concept

Comprehensive data was gathered for performance improvements

Toroidal Drive monitored
The Toroidal Transmission

- Light-weight
- Zero noise
- Zero vibration
- 96% power transmission
- Cost effective manufacturing

The Toroidal Transmission allows for the use of available higher RPM generators that offer not only a proven track record but a much lower cost than heavier, low RPM permanent magnet units.
The Toroidal Transmission

The simplest design is always the best design.
Data gathered from the Prototype:

The turbine tested was superior to existing designs.

The Toroidal Drive facilitates deploying a UPG in slower moving currents while extracting more kinetic energy from the water.

Aquatic life is not affected by physical impact with the turbine since the turbine speed is so low.

The Toroidal Drive's ability to provide absolutely silent operation yields no environmental footprint to impact aquatic life in a sonic way.

If water moving faster than 1.5 m/s is available, the kinetic energy increase thereby decreases the UPG in size while having the same electrical output.
MRK Flat Kable
Distance from Gulf Stream velocity core maximum to Bermuda is ≈ 485 miles (780 km).

Developed Cable in response to providing the most reliable, long term solution for Bermuda. Provides similar long term opportunity solution throughout the Caribbean Basin.
MRK Flat Kable
MRK Flat Kable
MRK Flat Kable
MRK Flat Kable
Australia
• **NSW INTEGRATED PORT AND RAIL FREIGHT NETWORK BUSINESS & INDUSTRIAL DEVELOPMENT ZONE PROJECT – the Yamba Port and Rail – (Y.P.R.) PLAN**

• **Port Yamba** - This project proposes the regeneration and expansion of Port of Yamba located on the North Coast of New South Wales.
Current 2 Current Australia Pty. Ltd

- **East - West Railway Development** – To be known as the Pacific West Railway, this project proposes the construction of approximately 500 kilometers of new railway between Port Yamba and Moree.
• **Western Rail Freight Access Corridor** – this project proposes the construction of a new rail freight corridor between Lithgow and Campbelltown. Preliminary mapping and development costs have been completed. This rail route can be easily rerouted to align with the proposed Badgerys Creeks international airport facility.

• **PROJECT 5.**
• **WESTERN SYDNEY INTERMODAL FREIGHT TERMINAL** – this project proposes the construction of a fully integrated rail terminus and inter-modal freight terminal. This project could also become a strategic extension of the Badgerys Creek airport facility and services.

• **PROJECT 6.**
• **PACIFIC TRADE COAST DEVELOPMENT ZONE** – this project proposes the development of a new northern NSW trade development zone.
AFFILIATED PROJECTS
A.I.D has entered into a Memorandum of Understanding (MOU) with the principals of each of the below listed companies.

CURRENT 2 CURRENT PTY LTD

Ocean Current 2 Current Power Generation:
The currents off the NSW coastline run north to south at a constant 5 knots.
This “off the shelf” technology takes advantage of the naturally occurring deep ocean currents to provide 24/7 base load power. With the underwater generators anchored 150 meters below sea level it will avoid any problems with navigating ships, it is also “out of sight and out of mind”.
Electricity will be produced and transmitted via electrical cable buried below the ocean bed to avoid any possibility that fishing vessels would get tangled.
With the generators impellers rotating at the same speed as the currents (5 knots) there is no danger to sea life or adverse effects because of noise.
The electricity will transmitted as 11kV from the generators to an onshore substation where it will be connected to the National electricity grid.
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C2C’s competitive advantage is efficient power generation, in a small footprint, with low capital cost.

**Turbines required to generate 10 megawatts**

- C2C (1)
- Lunar Energy (2-5) 2008 Plan
- Marine Current Turbines (7) Existing
- Blue Energy (40)
- Ocean Renewable Power (4)
- Gulf Stream Energy (4)
C2C’s engineering team is among the most experienced in the world.

- **Dr. Manfred Kuehnle, Founder**
  - Designer of Military Optical Reconnaissance Satellites.
  - Granted over 600 patents; sold licenses and business related to patents.
  - Recipient of Rudolf Diesel Medal and Carlson Award.

- **Dr. Herman Statz**
  - MIT
  - Raytheon, Director of Research (retired)
  - Developed first laser to shoot from earth to the moon.
  - Recipient June 2005 IEEE Pioneer Award.

- **Dr. Jim Pappis**
  - MIT
  - Specialist in materials science and production and nanoparticles.
  - Inventor of ALON optical materials.

- **Dr. Ted Hoff**
  - SRI
  - Inventor of the microprocessor at Intel.
  - Recipient of Kyoto Award and the Wilhelm Reis Medal.