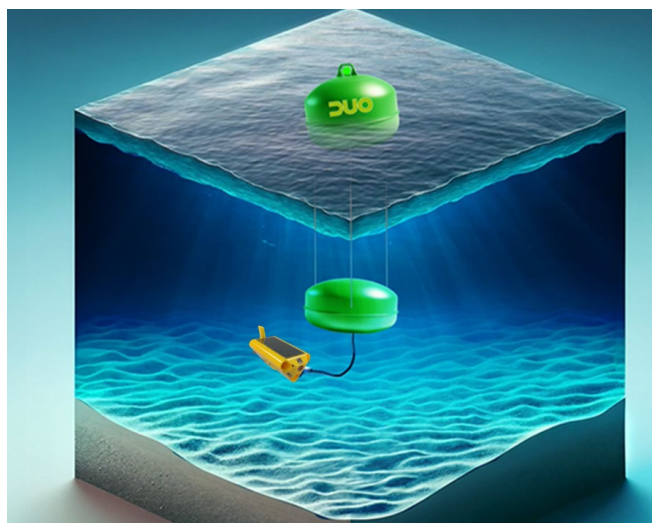


Node Zero A Wave-Powered Ocean Observation System

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Company Overview



About

A Global IT/Electronics/Robotics Company primarily focused on solutions for defence, aerospace and government needs.



Founded

Founded in 1985 and Headquartered in Canada



Employees

Approximately 70 employees in 4 offices



Quality & Security

- ISO 9001:2015 QMS
- Cyber Essentials Plus (CE+)
- ISO/IEC 27001:2013 (pending)
- Controlled Goods Program
- Facility Clearances
- Personnel Clearances



Global Access

- Two offices in Canada
- U.S. subsidiary in Chantilly, VA, USA
- European subsidiary in The Hague, Netherlands
- Extensive global experience in Canada, USA, EU, Japan, Caribbean & more



Products and Services

- ✓ Secure web-based & mobile Geospatial Information Systems (GIS)
- ✓ Robotics systems, especially Uncrewed Ground Vehicles (UGVs)
- ✓ Autonomous Systems and Services for Coastal and Infrastructure Monitoring
- ✓ Software & Electronics for Sensor Management & Internet of Things (IoT)
- ✓ Web, desktop, and mobile Asset Management and Inventory Control Systems
- ✓ Web-based portals and mobile applications incorporating data aggregation, management, fusion, visualization, analytics, dashboards
- ✓ Assistive Technology (AT) products for persons with disabilities

THE OPPORTUNITY

- Wave energy is globally one of the largest untapped renewable energy resources:
 - Canada's wave energy resource potential is about 184,000MW
 - U.S. wave energy resource potential would be similar in scope
- Despite ongoing prototype testing of Wave Energy Conversion technology for grid-connected power, development is hampered by:
 - high risk
 - high capital expense nature compared to utility scale generation
 - challenges of competing with more mature sectors such as offshore wind
- To reduce risk and accelerate commercialization of the technology, an alternative route to commercialization must be found
- Wave power systems can provide cost-competitive, safe, and green solution for powering at sea:
 - remote and off-grid applications
 - associated ancillary services (e.g., communication platforms for data transmission to shore)
 - ocean sensors and sensor platforms, including Autonomous Underwater Vehicles (AUVs)

CUSTOMER NEED

- Government and Defense agencies are actively seeking energy source alternatives due to economic, geopolitical, environmental and other factors
- Wave generated energy is also applicable to rural and remote locations, including the Arctic, where access to traditional power sources is costly to implement and maintain, and typically not environmentally friendly

THE SOLUTION: NODE ZERO

- An innovative, self-powered ocean observation / vessel recharging station
- Uses renewable energy available from ocean waves and the sun to provide power at sea for ocean observation
- First of a global network of next-generation wave-powered, data collection buoys and marine autonomous systems hubs
- Funding support from The Canadian Ocean Supercluster and Innovate UK



Node Zero Core Project Team

- Compusult Limited (Canadian Lead Participant)
 - <https://www.compusult.com>
- GRi Simulations Inc. (Second Canadian Participant)
 - <https://www.grisim.com>
- Institute for Ocean Research Enterprise (IORE) operating as COVE (Canadian subcontractor to Compusult and GRi)
 - <https://coveocean.com/>
- Pure Marine Gen Ltd (UK Lead Participant)
 - <https://puremarinegen.com/>
- Queen's University Belfast (Second UK Participant)
 - <https://www.qub.ac.uk/>
- PicSea Ltd (UK subcontractor to Compusult and GRi)
 - <https://www.picsea.co.uk>

Node Zero Partners and Technologies

These organizations are contributing their core technologies and expertise:

- **Compusult Limited:**
 - Nanuk Uncrewed Ground Vehicles (UGVs) for coastal monitoring support, data hub, and coastal launch and retrieval system for AUVs,
 - Environmental sensors and communications systems for the wave energy buoy & UGVs
 - Web Enterprise Suite (WES) platform for management of and access to all data from sensors on wave energy buoy, AUVs, and UGVs
- **GRI Simulations:** VROV Simulator and iDEA-DT software for simulations and digital twinning of the systems and deployment sites
- **COVE:** Ocean ecosystem engagement to identify further ecosystem partners, potential sites for deployment, and revenue generation opportunities, as well as digital data for the field test site
- **Pure Marine:** DUO Wave Energy Converter buoy
- **Queen's University Belfast:** System test facilities and technical support
- **PicSea:** PicSea300E AUVs and docking /recharging solutions

Compusult Node Zero Technologies – Nanuk UGVs

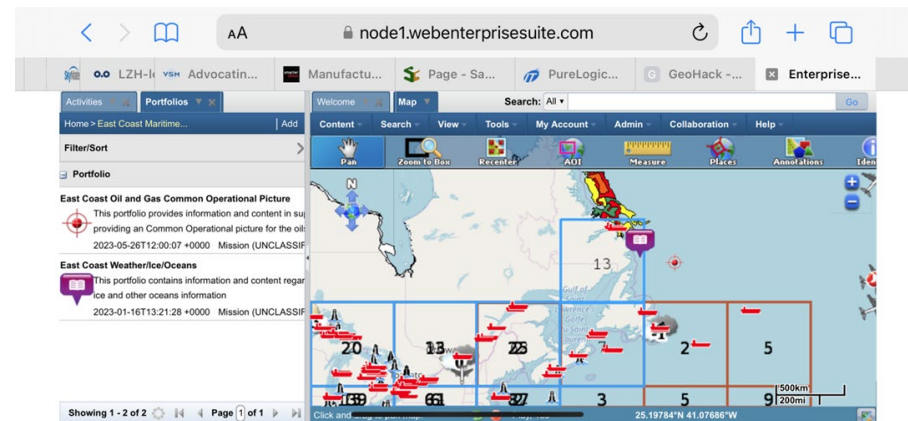
- Mobile platform for autonomous, semi-autonomous & remote-controlled operations
- Entire system in a single integrated platform
- Optional robotic arms, with various arm types and degrees of freedom
- Vision system: 2D/3D cameras plus LiDAR
- Various configurable sensors and mounts
- Onboard Robot Operation System (ROS) based software on the UGV
- User-friendly GUI for Remote Control
- Control from anywhere via web browser
- Rechargeable Lithium-Ion, Lithium Polymer, or Lead Acid battery packs
- Wireless charging option also available
- Traverses various terrains and climbs surfaces (different drive options available)



Compusult Node Zero Technologies – WES

The Total Geospatial Solution

- Standards-based, commercial software for comprehensive Geospatial Information System (GIS) capabilities and data aggregation
- Timely access to data, products, and services, including near real-time for systems, sensors, and historical data
- Quick & easy access, discovery, 2D/3D visualization, fusion, analysis and sharing of data, products and services for areas of interest, incidents & events
- “Big Data” management for huge volumes of geospatial and other data, digital imagery, and metadata, including hundreds of millions of items and thousands of concurrent users



GRI builds simulators for industrial robotics systems, creating realistic, data-rich virtual environments to enhance innovation and decision-making.

GRI SIMULATIONS

Node Zero Project Tasks:

- Digital twins of project wet-testing environments, including Ketch Harbour and Halifax Harbour
- Simulation, mission-planning & rehearsal, and real-time monitoring of PicSea AUV during project operations
- Simulation of DUO wave energy buoy, including integration and visualization of associated data through Web Enterprise Suite (WES)



VROV
Virtual Remotely Operated Vehicle

IDEA
Digital Twin

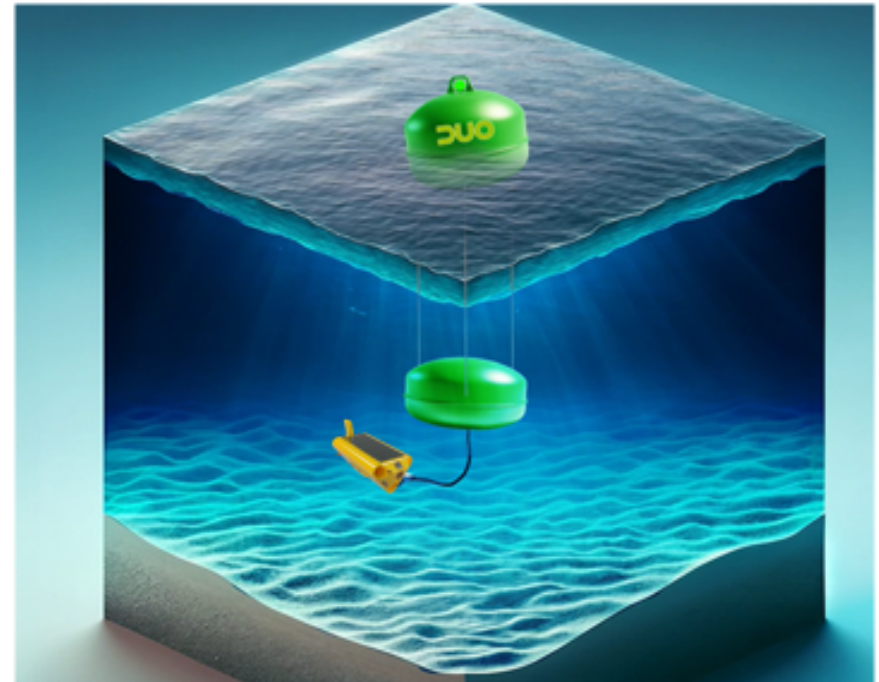
Pure Marine - a wave energy technology business

“Node Zero”

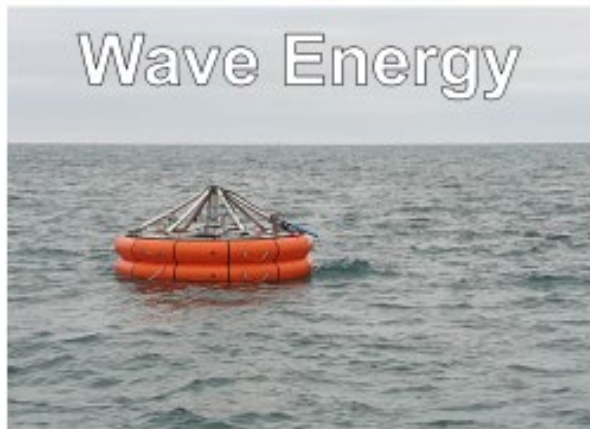
Development of a wave and solar powered ocean observation buoy using patented DUO technology.

Development of a garage for recharging of the PICSEA autonomous vehicle.

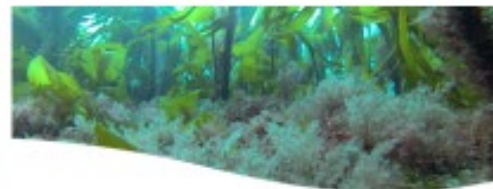
Integration of comms equipment & software development to upload data captured by the PICSEA vehicle and receive ‘next mission’ instructions.



Wave Energy



Environmental



Tidal Energy



Offshore Wind



Offshore Solar



PIC
SEA

Automated Underwater Vehicles Pioneering Seafloor Exploration



**CUTTING-EDGE TECHNOLOGY:
LIGHTNING-FAST & ACCURATE AUVS FOR SEAFLOOR DATA.**





Where marine
innovation meets
excellence

- High-tech innovation hub for the global **defence and security, offshore energy, fisheries and aquaculture, marine transportation and tourism** sectors.
- COVE provides **strategic network-building opportunities, connections and thought leadership** amongst the global marine tech community.
- Home to more than 65 local and global marine technology **businesses, start-ups, researchers and service businesses**, COVE engages with a global network of **3000+ companies, academic institutions, and government partners**.
- COVE will provide **ecosystem engagement support** for Node Zero, leading **customer engagement and scoping additional partnerships**.
- Node Zero will also be **integrated into COVE's Digital Harbour Initiative**.

COVE

BUSINESS AND REVENUE MODEL

- A typical, long duration deployment, lasting several months will likely require constant on-site vessel operations costing between USD \$3,000 to \$13,000
- A 50-day mission could costs of over USD \$300,000
- The DUO powered system would eliminate the majority of these vessel costs
- One such deployment would pay off all system costs
- The remainder of the expected five-year system lifespan is then pure profit

COMPETITION

- DUO Wave Energy Converter (WEC) reduces costs and operating constraints compared to other WEC systems
- Competitive compared to wind, solar and diesel-powered systems currently used to power ocean observing systems
- Some WEC R&D projects ongoing in the USA and the UK:
 - Mocean, attenuator device, by Mocean Energy (Scotland)
 - SeaRAY, point absorber device, by Columbia Power (USA)

WEC Type	Can be Integrated into Existing Buoy	Power to Buoy Size Ratio	Mooring and Anchor Size	Construction and Deployment
DUO	Yes	High	Simple catenary mooring & no anchor for energy capture	Standard materials and vessels
Attenuator	No	Medium	Complex directional mooring	Large vessel needed
Point Absorber	Maybe	Low	Very large anchor	Specialized vessel and anchor needed
Seabed Mounted	No	Low	Very large anchor	Specialized vessel needed

COMPETITIVE ADVANTAGE

	Low Lifecycle Cost	Data Availability	Ownership & Location Flexibility	Health & Safety	Decarbonized Solution	Additional Functionality
DUO Buoy	✓	✓	✓	✓	✓	✓
Diesel Generator, Wind & Solar Buoy	✗	✓	✓	✗	✗	✗
Wind & Solar Buoy	✗	✗	✓	✗	✓	✗
Nacelle Mounted	✓	✓	✗	✓	✓	✗
Met Mast	✗	✓	✗	✗	✗	✗

TARGET MARKET

- Marine Renewables Canada's 2021 Blue Economy Strategy Report predicts the rate of growth in the offshore wind sector in the last 20 years will be reproduced in the wave and tidal sector between 2030 and 2050
- Developing wave power technology to exploit these near-term market opportunities will propel wave energy on a pathway towards larger scale commercialization and use of abundant renewable energy resource in ocean waves
- Targeted end users include:
 - Developers of offshore wind projects who undertake environmental surveys, resource assessments, and geological and hydrological surveys
 - Government departments that are considering procuring observatories in remote locations, where the wave power solution provides a lower-cost solution than cabled stations.
 - AUV manufacturers seeking solutions to extend the mission life and sensor payloads they can offer to their clients
 - Defense agencies, in particular navies and coast guards, requiring novel sources of energy for at sea systems and platforms
- Distribution channels would be through strategic partners in each country

PROJECTED GROWTH

- Immediately after Node Zero project completion, we expect to deploy two systems to NRC Canada generating USD \$75,000 each per year
- A further five are expected to then be deployed in the UK and Canada resulting in a revenue of over USD \$500,000/year and profit of USD \$175,000/year
- 20 to 30 units per year are then forecast to be deployed yielding additional revenue of USD \$1.5M/year
- Additional deployments in other markets, such as the USA, are expected to generate recurring annual revenue several times the above amounts
- Potential risks are from other competitors, but their products are expected to have higher costs and greater limitations

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