

HARNESSING TIDAL STREAM POWER FOR A MORE SUSTAINABLE FUTURE



SUMMARY

I. The company

II. SABELLA tidal stream technology

III. D10 project : presentation & feedbacks

IV. Future developments

V. Main projects & procurement opportunities

I. The company

Driving force of the energy transition, 10 years of experience in ocean energy

2008 | D03-30

1st tidal turbine installed in France during 12 months

2015 | D10-1000

1st tidal turbine to supply electricity to the French grid

Key facts

- Created in 2008
- 25 employees
- EPCI (Engineering, Procurement, Construction & Installation)
- ISO9001 certification
- 100% owned subsidiary in Canada (HYDRO-SAB)
- Indonesian consortium (MPS)
- Turnover: €1 million
- Shareholding structure: 25% of industrials, 50% of financials, 20% of founders, 5% of management

II. SABELLA tidal stream technology

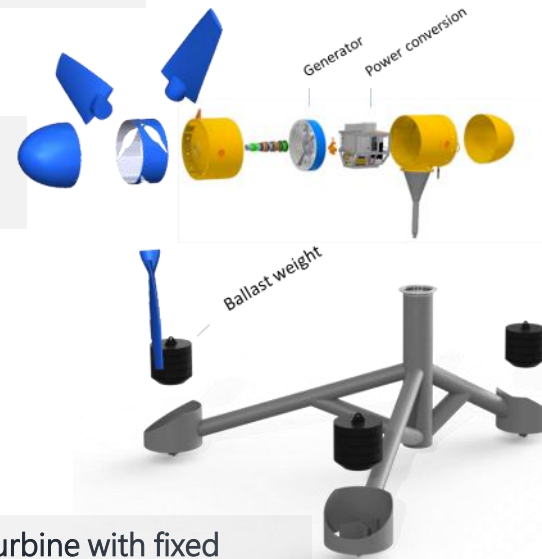
A cutting-edge technology for a differentiated solution

Direct drive generator with permanent magnets
No wearing parts

Onboard conversion chain and transformation with complete redundancy

Increased reliability in case of component failure

Low rotation speed
Marine life friendly



Modular architecture

Installation and O&M costs reduction

Horizontal axis turbine with fixed symmetrical blades and no yaw system
Improve yield, proven design and ruggedness

Gravity-based support structure with ballast weight
Environmental impact



II. SABELLA tidal stream technology

A complete product family to fit with local site characteristics

A range from medium to high power devices

- Rotor diameter depending on available water depth
- Rated power according to marine stream velocity

Main advantages

- Standardized sub-part to benefit the **volume economy** and ease the industrialization
- **Up to 25 meter diameter**
- Gravity-based or monopile foundation
- Rated power **from 250 kW up to 2 MW**



▼ D08-250

Rated speed @ 3 m/s

▼ D12-1000

Rated speed @ 3,6 m/s

▼ D10-500

Rated speed @ 3,2 m/s

▼ D16-1000

Rated speed @ 2,9 m/s

▼ D12-500

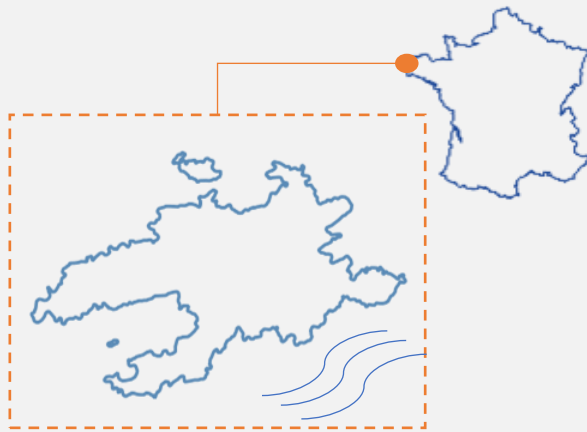
Rated speed @ 2,8 m/s

▼ D25-2000

Rated speed @ 2,75 m/s

III. D10 project

Ushant: insular, off-grid and autonomous



Ushant island

900 inhabitants – 4 Diesel power gensets,
Peak consumption 2 MW
7,000 MWh/year – 2 millions litres of fuel per year

SABELLA's projects on this island

3 steps from a first deployment in 2015 to the establishment of a tidal turbines array in the Fromveur Passage:

- 55 meters deep
- 2 km off the shore
- Up to 4.5 m/s (9 knots) current velocity

Step 1: D10-1000 mechanical and grid integrity and environmental compatibility ✓

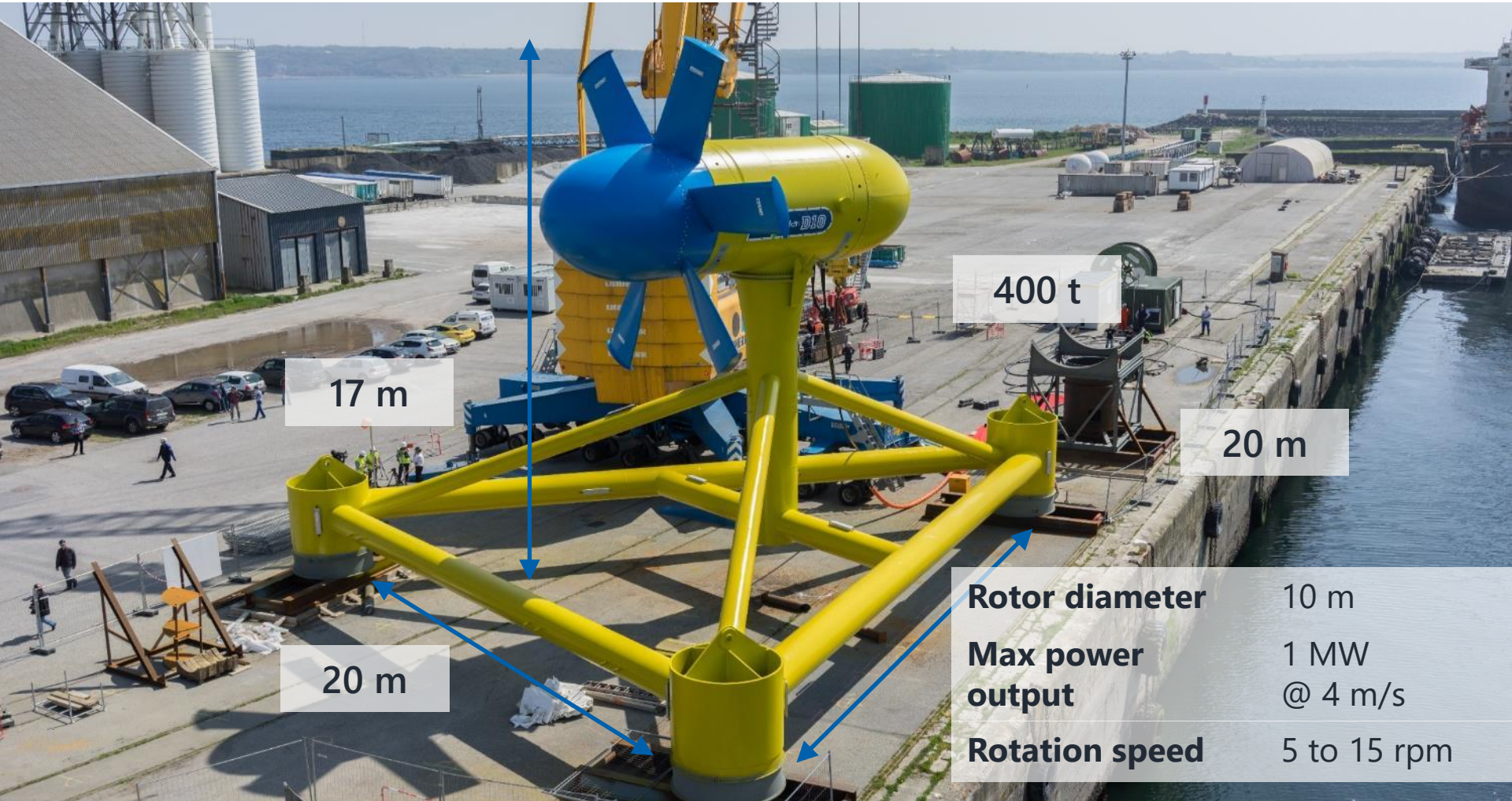
- Supported by the French government and Brittany region
- 1 MW device of 10-meter rotor diameter
- 2015: deployment in the Fromveur Passage and **connection to the electrical network of Ushant Island**, a weak and fragile off-grid network
- **Operation and monitoring** of the turbine during the 12-month authorized period

Environmental compatibility and operability assessed during the operations

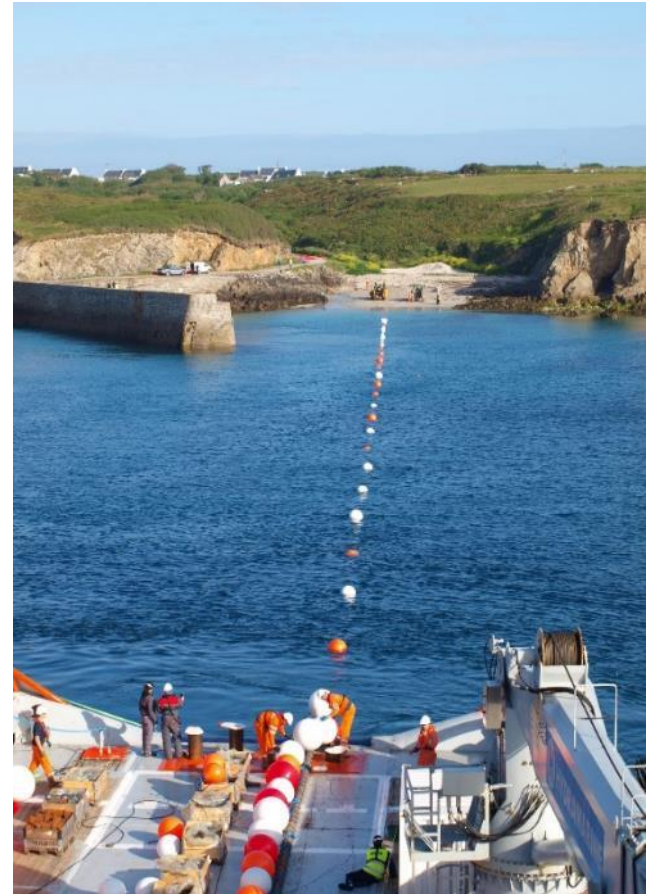


III. D10 project

Ushant: insular, off-grid and autonomous



III. D10 project Export cable installation (May 2015)



III. D10 project

Tidal turbine installation, June 2015

Installation strategy: All in one (GBS + Turbine - 400 tons)

Precision of positioning

- Small flexibility in Lat/Long
- 3° for orientation

Standard heavy lift vessel selected
Equipped with two 450-tons cranes
Maintained in position with 2 anchors and 3 tugs



III. D10 project

Connection to shore, September 2015



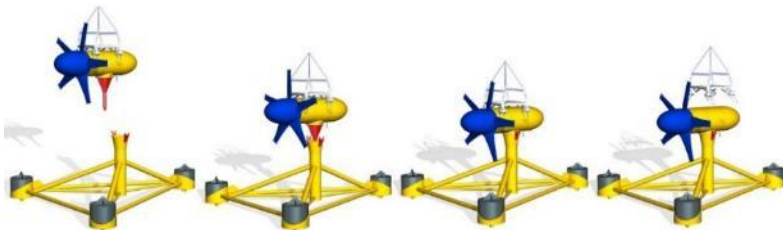
III. D10 project

Demonstration completion, July 2016

- **Turbine retrieval after 12-month authorized period**



- **Final re-installation test (turbine on her support structure)**



III. D10 project

Feedbacks

- **Anchored vessels not adapted for this operation**
 - Vessel not able to maintain her position, even with 3 tugs...
 - Damage on the jumper cable : loss of auxiliary power supply

- **Management of jumper cable complex and risky**
 - involves several dedicated operations during the installation or recovery of the turbine
 - export cable survey, recovery of the dry-mate connector, connexion / disconnexion on vessel deck, immersion of the connector
 - High risk of damaging the cable or the dry mate connector



IV. Future developments

Improvements for individual turbines

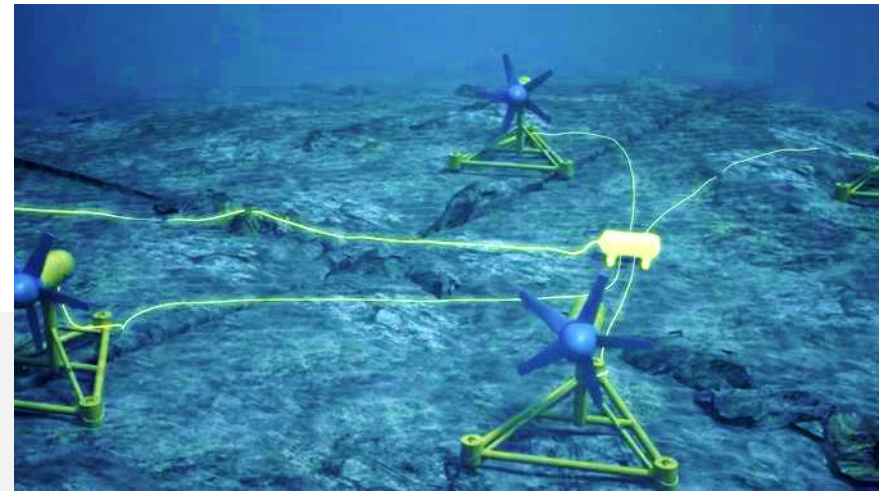
- **Wet-mate connectors to connect turbine to export cable**
 - No jumper cable to manage during turbine installation or retrieval;
 - Installation and connection at the same time : reduction of the duration and cost of offshore operations, increase of suitable weather windows;
 - Adaptation to tidal needs :
 - Connector integrating the connection of power, auxiliary supply and optical fibre;
 - Adapted to shallow water;
 - Fouling protection with vertical connection;
 - ...
- **Power cable monitoring**
 - Inspection without human intervention costly and complicated (ROVs, large vessels...)
 - inspection by divers complicated due to environmental conditions (strong current, high depths, low visibility, swell, waves)
 - Integrated monitoring for continuous survey of bend radius and for damage detection.
 - Sealing barriers to avoid water propagation in case of damage



IV. Future developments

Requirements for arrays

- **Subsea hub**
 - Interconnexion of 2 to 10 turbine to export production on a single cable
 - Hub containing a switch per turbine and a transformer
- **Export cable**
 - From 2 MW to 15 MW
 - 12 kV to 100 kV
 - Up to 80 fiber optics connexions
- **Wet-mate connectors**
 - On turbine side and on subsea hub side
 - From 250 kW to 2 MW
 - 6 kV to 12 kV
- **Dry mate connector**
 - Connection of export cable on subsea hub
 - From 2 MW to 15 MW
 - 12 kV to 100 kV
 - Up to 80 fiber optics connexions

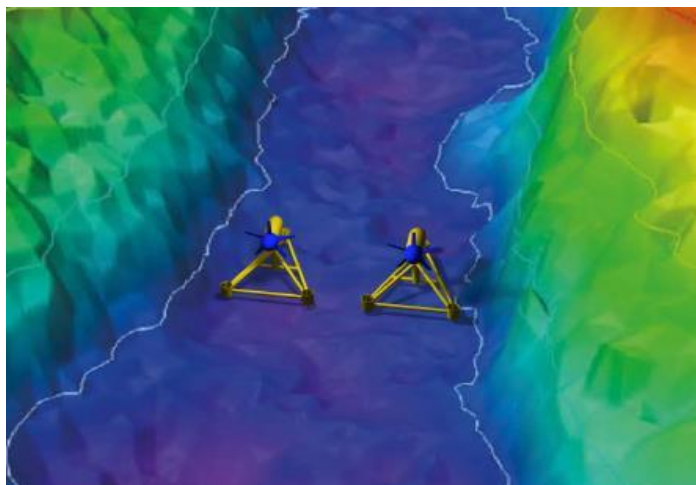


V. Main projects

Morbihan Gulf

Step 1 : TIGER project 2 x D08-250 – Site development and innovation ✓

- Project 60% financed by the **INTERREG Channel** Programme
- **Pilot farm of 2 tidal turbines (250 kW unit power) connected to the onshore grid** and coupled to hydrogen production units
- **Commissioning planned for 2022**, one year's experimentation as part of the TIGER project, then operation for 20 years.
- Integration into the energy mix of the Gulf region for autonomous and carbon-free production
- **Procurement opportunities :**
 - Wet mate engineering and supply
 - Export cable 1 km long to supply and install (X2)



V. Main projects

Morbihan Gulf

Step 2 : Ile longue project 2 x D08-250 – Commercial phase ✓

- **farm of 20 tidal turbines (250 kW unit power) connected to the onshore grid** and coupled to hydrogen production units
- **Commissioning planned for 2026**, operation for 20 years.
- **Procurement opportunities :**
 - Wet mate supply (X18)
 - Turbine connection cable of 100 m long (X20)
 - Subsea hub for interconnection of 10 turbines (X2)
 - Export cable 1 km long to supply and install (X2)

Step 3 : Berder project 2 x D08-250 – Commercial phase ✓

- **Additional farm of 20 tidal turbines (250 kW unit power) connected to the onshore grid** and coupled to hydrogen production units
- **Commissioning planned for 2030**, operation for 20 years.
- **Procurement opportunities :**
 - Wet mate supply (X20)
 - Turbine connection cable of 100 m long (X20)
 - Subsea hub for interconnection of 10 turbines (X2)
 - Export cable 2 km long to supply and install (X2)



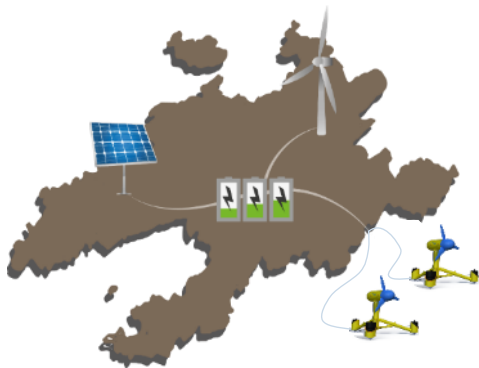
V. Main projects

Ushant: insular, off-grid and autonomous

Step 3: PHARES – 2 tidal turbines – Commercial phase ✓

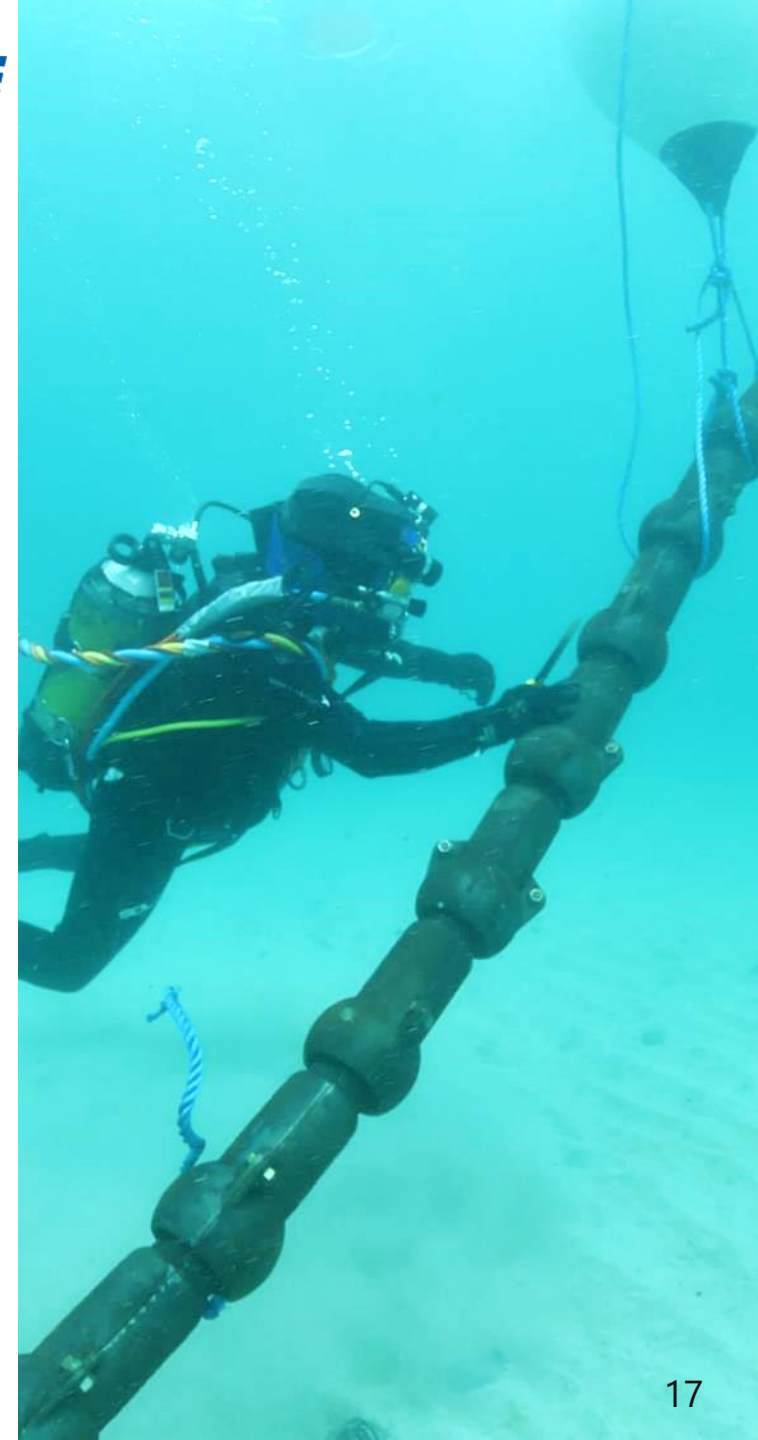
- Showcase for the “Fuel Free Island” energy model
- Led by AKUO Energy, final step of Ushant’s energy transition toward a green energy mix
- **Deployment of two tidal turbines, one wind turbine, solar panels and energy storage capacity**
- Commissioning in **2022**, 20-year period operation
- **Procurement opportunities :**
 - Wet mate engineering and supply
 - Export cable 2 km long to supply and install (X2)

The first commercial turbines array in France



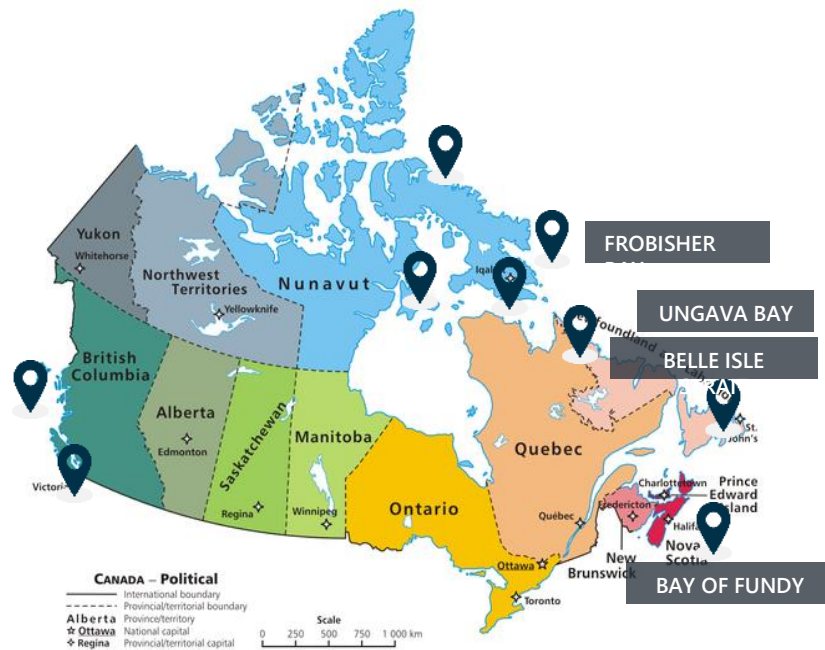
Two tidal turbines of 500 kW each, one wind turbine of 900 kW, 500 kW of innovative solar panels solutions and an energy storage (Li-Ion) of 2 MWh.

Total power: 2.4 MW



V. Main projects

Canada: from Bay of Fundy to subarctic off-grid areas



- A consequent **tidal energy resource** with tidal range up to 21 m (70 ft)
- **Strong marine currents** in Nunavik (Quebec), Nunavut, British-Columbia and Nova Scotia
- **Remote and off-grid communities and mining industries** with no interconnection
- Up to 100% dependence on fossil fuel generators to supply energy with a growing population
- **Awareness-raising of the population** towards their energy transition and the impacts of their greenhouse gas emission on their environment
- **Willingness to reach a cleaner and more diversified energy supply** to reduce the dependence on fuel and coal

BAY OF FUNDY - FORCE

SABELLA is developing a project, together with Canadian IPP TUGLIQ, to deploy a 4-MW tidal farm

- Commissioning planned for 2023-2024
- Procurement opportunities :
 - Wet mate supply (X4)
 - Turbine connection cable 100 m long (X4)
 - Subsea hub for interconnection of 4 turbines

Thank you for your attention!



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