GREBE

Northern Periphery and Arctic Programme 2014–2020

EUROPEAN UNION
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Nova Innovation Tidal Array Shetland

INNOVATION™
Nova Innovation Ltd

Introduction

Nova Innovation was founded in 2010 but has grown rapidly since its inception. They design, build and operate tidal energy devices, as well as, develop sites for arrays of tidal turbines. Nova Innovation is dedicated to engage with and source from local supply chains because they consider that the resources and know-how of coastline communities will contribute to the success of tidal power.

After a series of commercial failures in Scotland’s nascent marine power industry, including the collapse of two wave power firms, Nova Innovation’s determination to commercialize tidal devices did not change.

They succeeded in 2014 by successfully deploying and generating tidal electricity to the grid, with their Nova 30 tidal turbine (the previous model of the turbine) in the first tidal community energy project.

The Shetland Array is located in the North of Shetland, between the islands of Yell and Unst. The project is one of the world’s first in-sea tidal arrays. The tidal array will consist of five 100 kW tidal turbines, each of which will export electricity to the shore via a dedicated sub-sea cable.

Case Study Approach

The data on the market access of renewable energy technologies were collected both from the case studies in different renewable energy technology projects and from the secondary sources. To collect specific project data, a template was established with following subsections:

- **Technology description and a project summary**
  - Innovative characteristics
  - Technology readiness level
  - Available product / service supports from the manufacturer
  - Any standard procedures / requirements for integrating the technology into existing electricity networks, buildings and/or mainstream energy appliances / systems
- **Commercialisation of the technology**
  - Is the technology already a commercial solution?
  - Are there re-sellers of the technology, or is the technology available only from the manufacturer?
  - Identified main market area
- **Cooperation partners and networks**
  - Description of the roles of the co-operation partners and networks in the RE technology project.
  - How have they supported the market access of the technology?
- **Assessment of the technical and economic risks**
  - What kind of procedures have been made for assessing the technical and economic risks of the project
  - Who is bearing the risk of the investment (manufacturer, client, shared between them)?
  - Is the public sector involved in risk sharing? (e.g. co-financing, or platform for technology demonstration)
- **Drivers and barriers in the RE technology project**
  - Main drivers in carrying out the RE technology project
  - Barriers, and how they have been overcome (such as price of energy, availability of resource, specific expertise, policy enabling the technology)
- **Funding and support mechanisms**
  - The financial support received by the project: amount/support rate, type and purpose of the support, agency providing the support, significance of the support for the project
  - Types of soft support/advisories received during the project: the use of soft supports (advisory, training, mentoring etc.) during the technology development or implementation, and how successful these have been
- **Monitoring the performance**
  - How are the technical/non-technical aspects of the RE technology case monitored?
  - Information on the design, installation requirements and procedures, operational performance, and costs/financial arrangements
- **Conditions for the technology transfer & adaptation in different partner regions**
  - What are the main requirements/preconditions for transferring the technology and applying it in other partner regions?
  - Description of the main drivers and barriers for the technology transfer (such as. Energy price, resource needs, certain support etc.)
- **Project results**
  - Benefits & lessons learnt
  - Post- project benefits

Technology Description

Each tidal turbine consist of a cylindrical nacelle component, rotor and gravity base to lock it to the sea bed (no seabed drilling or extra site works are needed). The negatively buoyant nacelle is securely linked to the base by the means of a latching system. The five Nova M100 devices are bottom mounted, gravity anchored, non-yawing, horizontal axis tidal turbines.

The turbine has a rotor diameter of 10 m, and a hub height of 9 m, making the total height 14 m from the bottom of the feet to the tip of the blades. In the Bluemull Array the devices will be mounted in water depths greater than 30 m, so clearance will be more than 15 m below mean tide. The footprint of the device is 13.5 x 12.2 m, and the weight in water is 80 tonnes. The device will work in a maximum sustained tidal speed of 2.6 m/s and is attached to the seabed at a position that guarantees throughout operation. All parts of the turbine are at least 15 m below lowest astronomical tide, to permit sufficient draft clearance for shipping.

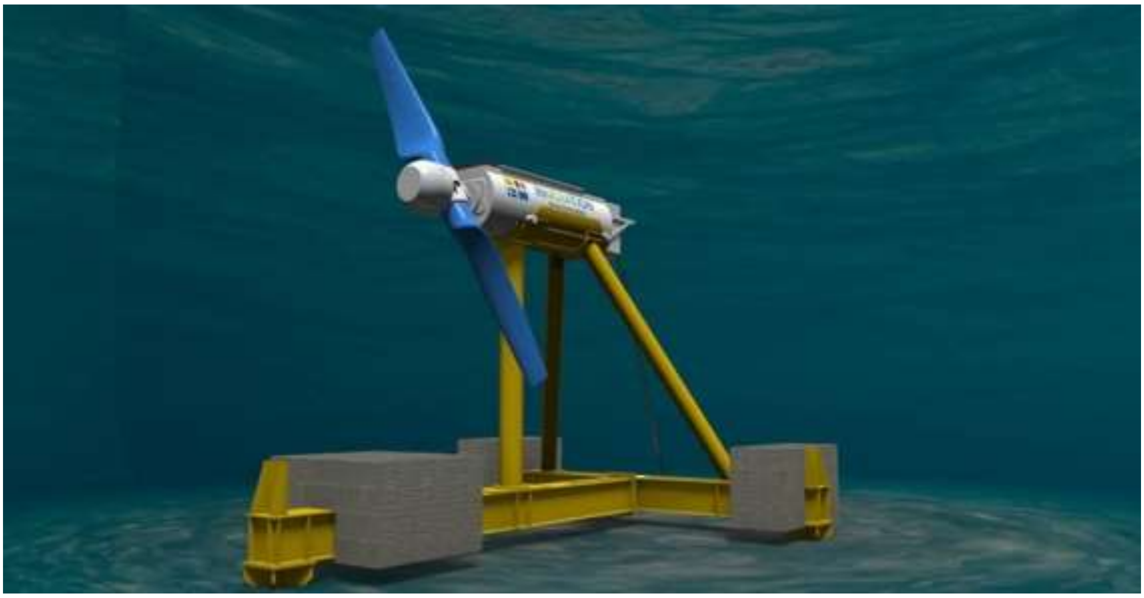

Figure 1. Nova Innovation Tidal Device

TRL and Technology Scale

The technology is considered TRL 9, as it is proven and patented tidal energy technology. There is also evidence on operation on a commercial basis.

Cooperation partners and networks

The Nova Innovation Tidal Array project has both private and public partners:

- ELSA - Belgian renewable energy leader is partner developer to the project, providing project management expertise and operational input, as well as financial support.
- Scottish Enterprise and the Renewable Energy Investment Fund (REIF)
- Shetland Composites – Manufacturer of the blades.

Risk assessments and supports received

Technical risks assessments include Cable Protection Risk Assessment, Navigational Risk Assessment, Natural habitats47, and Construction Phase Emergency Response Cooperation Plan. The risks are shared between the developers and investors.
The public sector has participated through the financial supports, and shared some economic risks of the new technology demonstration and deployment.

Scottish Enterprise and the Renewable Energy Investment Fund (REIF) – provided funding – £1.9 million grant.

In the autumn 2016, Nova Innovation received a Horizon 2020's SME Instrument grant of € 2.25 million to develop a commercial demonstrator of Nova's innovative direct drive tidal turbine technology (Phase 2 of Shetland Array) to develop a commercial demonstrator of Nova's innovative direct drive tidal turbine technology.

Drivers and barriers

The main drivers for this technology are related to the resource and its place-based potential by building on the previous development projects and lessons learnt:

- The Highlands and Islands is home to one of the most dynamic tidal areas in the world - the Pentland Firth and Orkney waters. This area of sea off the northern coast of mainland Scotland, and including the waters around the Orkney Islands, contains 50% of the UK's tidal resource and 25% of Europe's tidal resource. Some studies suggest that one-third of the UK's total electricity needs could be met by tidal power alone.
- Shetland is an island and as it is the case with many islands in the NPA region, the drivers for an energy project include power stability, reliability (security of supply) and lowering the costs of electricity.
- An acknowledged barrier associated with the technology is connected with tidal cycles and turbine efficiency. The load factor of a conventional tidal barrage is around 25%, which leads to high cost of energy.

Conditions for the technology transfer, adaptation and new market deployment

The technology transfers are considered to benefit of following factors:

- Reliable supply of power.
- Importing/transferring knowledge and experience from other industry sectors, such as offshore oil and gas installations and offshore wind farms, including risk assessments, environmental impact assessments and engineering standards.
- Socio-economic benefits, especially the development of local supply chain should be a key driver of economic regeneration for coastal communities. Harnessing the wave potential and ensuring a share of these economic benefits accrue to local communities could contribute to local economic development by exploiting synergies with other sectors.

There are also several identified barriers for the technology transfers, as follows:

- Financial Risks (high upfront costs) - shortage of upfront capital investment for the technology development and pilot array demonstration, which is further amplified by the absence of long-term transparency on revenue supports.
- Ecological implications - Deficiency of data to effectively evaluate impacts on the marine environment, is a challenge for authorities to provide consent for development of tidal projects.
- Technology risk - reservations concerning survivability, dependability and cost saving potential, especially for those designed for offshore operations in harsh environments.
- Grid risk (location and connectivity issues) - Peripheral/remote/isolated positioning of many of the areas with good potential, means substantial chunks of investment are needed for grid reinforcement, to guarantee energy generated, feeds into them.
- Technical risks in design, construction, installation and operation, lead to high costs. Costs need to be brought down to at least 50%, in order to be equivalent to offshore-wind energy generation costs.

From a market development perspective, The Nova M100 (10 kW tidal turbine) has the following benefits:

- Safe and reliable deployment and maintenance.
- High reliability: use of robust, proven off-the-shelf parts.
- Low cost: Industry-leading lifetime cost of energy; widely available deployment vessels, ease of transport, laydown and maintenance.
- Ease of transport - Nova's modular system means tidal power plants can be transported and installed around the world using standard containers and lorries.

Project Results

Benefits

This is the deployment of the world’s first operational, grid-connected offshore tidal array in Shetland, sending electricity on a commercial basis into Shetland’s local grid.

The project has 100% EU content and with over 80% Scottish supply chain content, demonstrating Nova’s commitment to local supply chain engagement.

Lessons Learnt

Drawing on past lessons from the wind power sector, Nova Innovation aimed at demonstrating commercial devices at a small (sub-megawatt) scale, then scale up in size “think big, start small”.

The Nova M100 tidal turbine is the next generation device, which builds on the successful design, manufacture, testing and deployment of the 30 kW Nova 30 device. Although the device is three times more powerful than the Nova 30, it is only twice the cost. It is expected to have lower operating costs, improved reliability and increased energy output.

Post Project Benefits

Nova Innovation has received an agreement for lease from The Crown Estate to explore the potential of Bardsey Sound for tidal power generation, which enables them to start fully exploring the project's potential through site surveys and studies to inform the technical feasibility. They teamed up with regional renewable energy organisation YnNi Llŷn, to develop a tidal energy project at Bardsey Sound off the Llyn Peninsula in north Wales.

Nova Innovation is keen to explore ways in which local businesses can be involved in the project, using the expertise and experience in the local area to provide services to support the development, verifying the company's strong commitment to local supply chain sourcing.

Contact Information

Nova Innovation Ltd
Clockhouse, Bonnington Mill, 60-72 Newhaven Road, Leith, Edinburgh, EH6 5QG
Tel: +44 (0)131 554 2242
Email: info@novainnovation.com
Website: www.novainnovation.com

PARTNERS

GREBE will be operated by eight partner organisations across six regions:

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