CHARACTERISATION OF 24 NON-INTERCONNECTED ZONES

19/07/2020

Samuel Prouten, Benjamin Lecoeuvre et Mathieu Mith

Students of ENSTA Bretagne

Members of Junior IMPACT

About ICE

Supported by Interreg VA France (Channel) England, the Intelligent Community Energy (ICE) project, aims at designing and implementing innovative smart energy solutions for isolated territories in the Channel area.

Islands and isolated communities face unique energy challenges. Many islands have no connection to wider electricity distribution systems and are dependent on imported energy supplies, typically fossil fuel driven. The energy systems that isolated communities depend on tend to be less reliable, more expensive and have more associated greenhouse gas (GHG) emissions than mainland grid systems.

In response to these problems, the ICE project considers the entire energy cycle, from production to consumption, and integrates new and established technologies in order to deliver innovative energy system solutions. These solutions will be implemented and tested at our unique pilot demonstration sites (Ushant island and the University of East Anglia's campus), to demonstrate their feasibility and to develop a general model for isolated smart energy systems elsewhere.

The ICE consortium brings together researcher and business support organisations in France and the UK, and engagement with SMEs will support project rollout and promote European cooperation.

Table of contents

1. Introduction

The objectives set by the Technopôle Brest Iroise (TBI) as part of the 200420_CE29_Brest-Iroise study are to identify the NIZs (Non Interconnected Zones), mainly in the English Channel, to assess the markets linked to them in terms of energy and to evaluate the political will of these different NIZs.

Phase 1 of this study, described in the current report, concerns the identification of 24 NIZs. These are all islands or archipelagos, mainly located in or around the English Channel region. The NIZs selected also include NIZs located in other parts of Europe and outside Europe. This phase was based on part 1 "Identification of Interconnected Zones" in the method of 27/03/2020 provided and written by Johan Daelman, student of the Specialised Master in Marine Renewable Energies at ENSTA Bretagne and Member of Junior IMPACT.

At first, thanks to the information in Johan Daelman's report, the definition of a NIZ and the associated criteria for identifying these territories are recalled. The complete process of identification of these 24 NIZ is then presented exhaustively, detailing the main criteria and then the prioritization criteria that allowed this selection. The databases used are also presented. These 24 NIZs are then represented on several maps using adapted mapping tools, allowing them to be visualized spatially. At the same time, a general description of all the NIZs identified is then written, containing the information that enabled their prioritization. Finally, a further extension is drawn up to identify territories not included in the 24 NIZs but which nevertheless have considerable potential, which could subsequently be of interest to the TBI.

2. NIZ identification process

A precise definition of the NIZ concept is set out in Part 1 of Johan Daelman's report with the following description: "an isolated territory is an off-grid system that involves small-scale (10 kW to 10 MW) electricity generation and serves a limited number of consumers via a distribution network that can operate independently of the national electricity transmission networks. ». The author then developed 4 main criteria on which we then based the identification of the 24 NIZ. He defines the term "system" as a set of means for the generation, transmission and distribution of electricity. These criteria are:

- Criterion 1: The system must be electrically isolated from surrounding systems.
- Criterion 2: The system must be capable of generating between 10 kW and 10 MW.
- Criterion 3: The population living in the territory served by the system represents a small proportion of the population politically affiliated with the territory.
- Criterion 4: A system whose distribution network capacity covers the needs of the demand but whose transmission network is not necessarily isolated from the national grid.

As these criteria are subject to multiple interpretations and subjectivity on certain points, detailed explanations will now be developed to remove any possible questions. The following is a comprehensive presentation of the guidelines that led to the final selection of the 24 NIZs.

First of all, after having listed more than fifty islands mainly located in Europe and around the English Channel, and potentially identifiable as NIZs, it soon became clear that it would not be possible to identify 24 islands electrically isolated from the continental networks. Perhaps this would have been possible but only if the research area had been extended to the whole world, but we then considered this enlargement less relevant considering of the objectives set by the study. So, to refer to criterion 1, we gave considerable priority to electrically isolated islands but we also considered islands on other energy distribution criteria. For example, islands that are not electrically isolated are mostly connected to the power grid by submarine cables, but these have a limited lifespan, which implies very expensive maintenance operations. Moreover, despite the electrical connection, several islands use considerable volumes of fossil fuels in parallel each year. Some of them have also explicitly expressed their willingness to turn to more renewable energy resources with a goal to achieve energy autonomy in the long term. These reasons therefore explain the broadening of criterion 1. Regarding criterion 2, we have based ourselves mainly on the upper limit of the system's production capacity, set at 10 MW. Indeed, the lower limit, initially set at 10 kW, seemed less relevant because some islands have, for example, a set of photovoltaic panels with a power of less than 10 kW. Thus, if the production capacity did not exceed 10 MW, we validated this criterion. For criterion 3, we tried to consider islands whose population represents a small proportion of the population politically affiliated to the territory and we also considered the population density, a prioritisation factor. Criterion 4, echoing Criterion 1, was applied to islands that are electrically connected to a national grid but whose installations have frequent power failures, resulting in damaging power cuts or exorbitant maintenance costs.

In addition to these 4 main criteria, we have also considered other prioritization criteria such as:

- Population density as previously explained.
- Geographical isolation with the shortest distance between the island and the mainland.
- Geographical location in relation to the English Channel with a prioritisation for the islands close to this region.
- The carbon footprint of the island and its consumption of fossil fuels for most of the selected islands.
- The island's already explicit willingness to turn to a maximum of renewable energies in order to decarbonise its electricity production.
- The possibility of potential markets for companies working in renewable energies and Marine Renewable Energies (RME) by drawing up the renewable resources available in the identified territories.

This approach to identifying NIZs was based on several carefully selected tools and databases such as:

- Geographic Information Systems (or GIS) such as QGIS; OpenStreetMap (OSM) with notably the Overpass turbo module and Open Infrastructure Map.
- Report 2.1.1 by Oscar Fitch-Roy et al (Oscar Fitch-Roy, 2018).
- Databases proposed by Johan Daelman in part 1 of his report but also other INSEE databases, for example for the population census of French municipalities.
- The local, regional and national press of the islands concerned, making it possible to answer several questions, notably on the means of electricity production of the islands and their electrical isolation or not. Indeed, the resources mentioned above were not exhaustive and the open source nature of some tools required a comparison with other sources of information.

3. Mapping of all 24 selected NIZs

Figure 1 - NIZ in English Channel and around

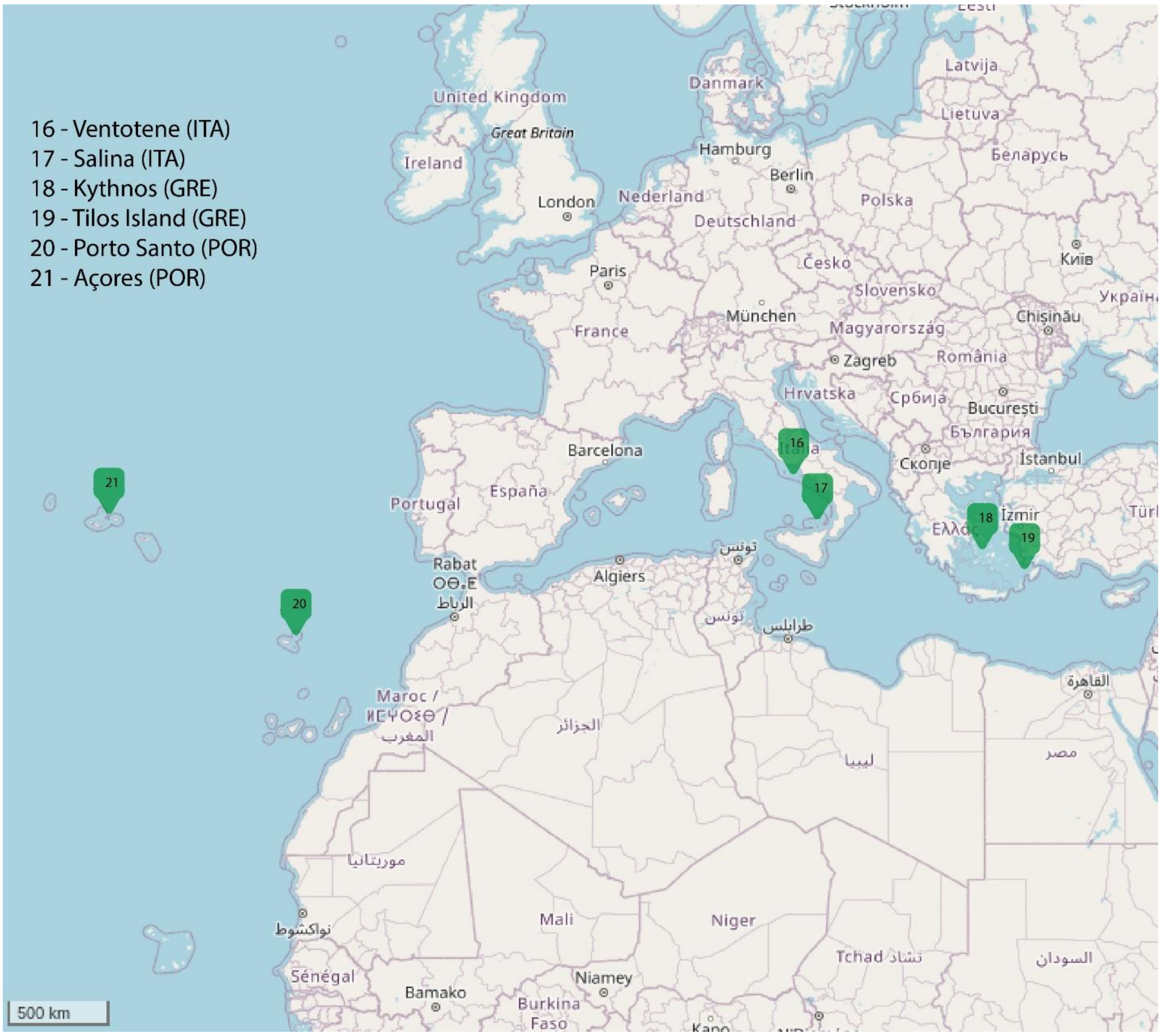


Figure 2 - NIZ in Europe

Figure 3 - NIZ outside Europe

4. General presentation of all 24 selected NIZs

4.1. The Glénan [France]

4.1.1 Island's presentation

The Glénan archipelago, attached to the commune of Fouesnant-Les-Glénan in Finistère, is located about fifteen kilometres from the south coast of the department. Known for its heavenly beaches, this archipelago is also known for its International Diving Centre and its world-renowned Nautical Centre, which is the largest sailing school in Europe, welcoming 17,000 trainees every year. The Glénan archipelago is made up of a dozen or so islands of varying sizes, the main one being the island of Saint-Nicolas with a surface area of 0.353 km², the only island accessible to visitors and on which there is a nature reserve. Penfret, Bananec, Cigogne and Drennec are occupied by the Nautical Centre. The other islands are ornithological reserves or private islands. Les Glénan, a Natura 2000 classified site, is not inhabited in winter but welcomes from April to November up to 3.000 visitors per day.

Not connected to the mainland by a submarine cable, this archipelago is completely isolated electrically. Its energy production is based on two oil-powered generators on the island of Saint-Nicolas. The archipelago has also had a wind turbine since the 1990s and photovoltaic panels since 2000. In addition, there is a real desire on the part of the archipelago to develop renewable energy sources on its territory in order to decarbonise its electricity production and diversify its energy mix. Its objective is to reach 100% renewable energy in the coming years. The island has a wide range of renewable resources, including wind, photovoltaic and marine energy.

4.1.2 Evaluation of electricity consumption

4.2.2.1 Electricity consumption on the island

Being part of the commune of Fouesnant-Les-Glénan, the specific electricity consumption data of the Glénan archipelago are unfortunately mixed with those of the entire commune. The data on the electricity consumption of this archipelago, whether on an annual, monthly or daily basis, could not be obtained despite the efforts made to find them. Indeed, many websites have been visited and searched in depth in order to find these data. French government databases do not present data related only to the archipelago. Nevertheless, we contacted the town hall of Fouesnant-Les Glénan twice. The first time by mail (02/07/2020) without any answer, then a second time (09/07/2020) directly by phone. During this call, the person from the town hall asked to return the first e-mail to forward it to the competent authorities but since then no return has been made. Due to the conjunction of a particular health situation which mobilizes a lot of means and the summer season, which is launched, it is possible that the answer of the authority only arrives during the summer.

4.2.2.2 Consumption patterns

This section presents the consumption pattern of the Glénan Archipelago. The least energy-efficient activities have been identified by local stakeholders and subsequently, several measures have been taken to control energy use in this archipelago. With the support of the Association des Iles du Ponant (AIP) and the municipality of Fouesnant-Les-Glénan, energy-saving measures have been implemented to reduce the volume of electricity consumed. For example, they involved replacing energy-intensive household appliances. The municipality has invested in new household appliances (class A+ and A++ refrigerators and freezers) to equip the municipal buildings. In addition, the island's users were informed of this opportunity because the AIP subsidised the purchase of new household appliances by 50%.

4.1.3 Evaluation of electricity production, transport and distribution means

4.2.3.1 Existing system

The following table shows the current electricity generation system on the island of St. Nicholas des Glénan.

	2 diesel generators	**Wind turbine**	**Photovoltaic park**		**Storage park**	**Energy Management System (EMS)**
Sector / power supply	Diesel	Wind	Solar		120 lead batteries	Energy optimisation software provided by EDF Store & Forecast
Island site	-	-	Base of the wind turbine	Roofs of communal buildings	-	-
Date of commissioning	-	1992	Since 2000 and an improvement in 2010	2018	Before 2019	Before 2019

Connecting power / Capacity	130 kW (65 kW each)	Reprogrammed in April 2019 to increase from 15 kW to 20 kW	160 modules (110 m²) for a power of 15kWp	115 photovoltaic panels for a power of 22 kWp	Storage capacity of 316 kW (recharged in 8 hours on average)	-

Table 1 - Existing electrical systems for the Glenan Archipelago

This efficient and innovative "micro-grid" is managed by Enedis, which is the manager of the archipelago's public electricity distribution network. Further details on the existing system are described below. For example, the generator room has also been fitted out to provide cooling and soundproofing in relation to local residents. The latter are present for use as a last resort. As for the wind turbine, it is equipped with an anemometer that measures wind speed and pressure, which helps to optimize energy consumption. The island of Saint-Nicolas des Glénan also has a Skyscope, which is a very short-term (about 1 hour) weather forecasting system for solar radiation based on a camera that collects information on the clouds passing over the solar farm in order to anticipate the means of photovoltaic and/or wind production. In addition, Linky meters enable consumers to monitor and control their consumption in order to optimize the entire system. In addition, the EMS (Energy Management System) pilots and optimizes all the production facilities and local flexibilities 24/7: photovoltaic production, wind production, the battery farm, the generator as a last resort and the compressed air storage system at the International Diving Center. This system also has a filter to protect all the installations from salty air and a hygrometry detector.

4.2.3.2 Evaluation of the market for innovative technology

As explained in Johan Daelman's preliminary study, characterising the Marine Renewable Energy (MRE) resource is an expert work generally attributed to research institutes. Having had a brief introduction to the different types of information needed to characterize renewable resources, the objective is now simply to identify the institutes able to provide this kind of data for different renewable resources with a strong interest in MRE. Where some information is provided by the institutes or other documentation, it will be presented to illustrate the summary table.

Then, the research carried out in the framework of this study has made it possible to access a lot of information related to this part via studies already carried out, websites, scientific articles, etc. The results gathered and deemed relevant will also be presented to give the reader a more precise idea of the renewable energy potential of this NIA. The figures from the different institutes will be presented in the appendix for a better readability of the report.

The following summary table presents the institutes able to provide energy potential characterization data for each of the associated resources for the Glénan Archipelago.

Resource Type	Institutes able to deliver resource characterization data
Tidal Energy from Tides	For France (and Europe to some extent), the tide directory of the French Navy's hydrographic and oceanographic service (SHOM - Service Hydrographique et Océanographique de la Marine) serves as a reference for a wide choice of ports.
Tidal Energy from Currents	The data portals of SHOM and the French Research Institute for Exploitation of the Sea (IFREMER - Institut français de recherche pour l'exploitation de la mer) have data on the intensity of surface and deep currents.
Wave Energy from Waves	IFREMER's MARC model is a good tool for obtaining a directional spectrum of the swell. In addition, CEREMA offers a service for the installation and operation of a wave measuring station.
Osmotic energy	The SHOM and IFREMER data portals are also to be queried first.
The thermal energy of the seas	
Wind energy	The Centre d'études et d'expertise sur les risques, l'environnement, la mobilité et l'aménagement (CEREMA) offers a service for assessing the potential deposits and impacts of marine renewable energies. The meteoblue platform shares local meteorological data for the whole world with a resolution of 30 km. In particular, wind roses are offered. For greater accuracy, they offer high-resolution simulations with hourly data.
Solar energy	The EU Joint Research Centre's solar modelling software, PVGIS, estimates the energy production potential that can be realised by photovoltaic solar technology on the basis of average solar irradiation for a given geographical location. The Global Solar Atlas also provides quick and easy access to data on solar resources around the world.

Table 2 - Presentation of the institutes providing renewable resource data for the archipelago of the Glénan

4.1.4 Evaluation of energy transition policies

4.2.4.1 Identification of local actors

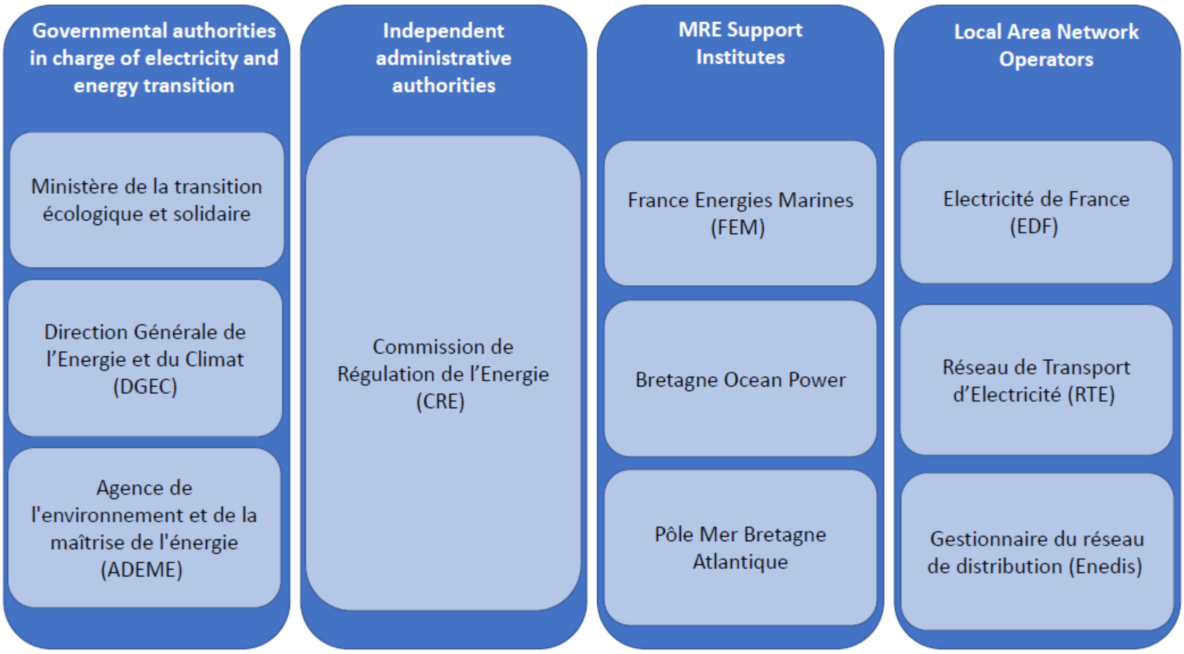


Figure 4 - Local actors of the Glénan

4.2.4.2 Identification of existing programmes and current energy transition policies

The Glénan archipelago, with its main island Saint-Nicolas des Glénan, does not benefit from an electrical connection to the continental grid. The lack of energy self-sufficiency and dependence on fossil fuels has thus prompted the commune of Fouesnant-Les Glénan, in collaboration with the Association des Iles du Ponant (AIP), to embark on an ecological and energy transition process to serve the 1,000 to 1,500 visitors welcomed on average per day between April and November, with peaks at 3,000 visitors. Since 2016, the AIP has been part of the national project Territoires à Energie Positive pour la Croissance Verte (TEPCV) (Positive Energy Territories for Green Growth) for all the Breton islands. The Glénan archipelago is also involved in this national project.

While preserving the Glénan's atypical biodiversity and environment, the municipality has focused on the development of renewable energies (ENR) by installing photovoltaic panels and a wind turbine. In 2017, 50% of the electricity consumed in Saint-Nicolas was produced by the wind turbine and photovoltaic panels. This energy transition project has also taken a new direction in recent years with the aim of achieving 90% energy autonomy in 2019 and 100% energy autonomy in 2021 based on renewable energy sources. The project on the island of Saint-Nicolas des Glénan, a real small-scale smart grid, therefore aims to interconnect energy production and the operating system in order to improve the energy efficiency of the island's grid. Since March 2019, Enedis, a partner of the municipality of Fouesnant-Les Glénan, has been working on completing and managing this micro ENR network with the aim of no longer using generators, except as a last resort. The means put in place to meet this ambitious project are numerous, as developed previously.

In addition to encouraging the installation of new systems, this energy transition project also takes into account the optimization of already existing systems. For example, the International Diving Centre (CIP) is the largest consumer on the island with 2 air compressors, equivalent to the electricity consumption of 5 single-family houses and a power of 30 kW. Previously, the CIP had 2 generators for its compressors in order to recharge the air cylinders. Today, it no longer has any generators. Indeed, this project allowed the installation of a compressed air buffer stock of 15 blocks of 80 litres which is associated with a flexible piloting. The starting of the compressors is then synchronized with ENR production peaks, helping to balance the system. Another island in the Glénan archipelago, the island of Drenec which hosts the Nautical Centre, is of course also concerned by this energy transition. It already has a solar water heater in the kitchen and wants to install a new one to heat the shower water.

In a context of energy transition and reduction of greenhouse gas emissions, the commune of Fouesnant-Les Glénan and Enedis have therefore opted for an intelligent network based on a mix of wind and photovoltaic energy, supplemented by a storage battery and a generator as a last resort. By investing €250,000 in the technology and implementation of this micro-grid, these two main players intend to use this innovative laboratory as a showcase for the energy transition for isolated territories.

In addition to the town of Fouesnant-Les Glénan and Enedis, the partners in this project are numerous: the Association des Iles du Ponant (AIP), the Syndicat Départemental d'Energie et d'Equipement du Finistère (SDEF), the SMILE association (Smart Ideas to Link Energies).

This project also emphasizes the use of the know-how of local and French companies such as ENAG, which supplied the energy conversion module, which makes it possible to control, convert, store and distribute electrical energy from photovoltaic panels, wind turbines, batteries and generators; the company Entech smart energies, which offers energy conversion solutions optimized for smart-grids in order to integrate new uses of energy ; MAYDAY ASSISTANCE, which, in partnership with Enedis, built the High Pressure Breathable Air inflation station for the CIP les Glénan; EDF Store & Forecast, which developed the island's EMS; and GENIWATT, which contributed in particular to the fitting out of the generator room to ensure cooling and soundproofing in relation to the local residents.

4.2.4.3 Assessment of the relevance of ongoing programmes and projects

The programmes and projects undertaken for the Glénan archipelago and for the island of Saint-Nicolas des Glénan are already at a very advanced stage. Nevertheless, in order to achieve 100% energy self-sufficiency thanks to renewable energies in the coming years, generators will have to be phased out. Indeed, the aim of this project is also to achieve "zero emissions" of greenhouse gases and the elimination of fuel oil transport between the mainland and the archipelago. However, the intermittent nature of renewable energy sources, particularly wind and solar power, could thus encourage the consideration of other sources of renewable energy, particularly MRE, in conjunction with the marine resources that border the archipelago.

Thus, in collaboration with the local authorities and the actors of the various projects in progress, it would be interesting to propose the implementation of new renewable energy sources not yet exploited.

4.1.5 Contacts

Contacts for electricity supply and power grid management	* Producer of electricity: **EDF** (Electricité De France) Website: https://www.edf.fr/contacts/institutionnels Local phone : 09 69 32 15 15 * Electricity Distribution System Operator: **ENEDIS** Website: https://www.enedis.fr/enedis-en-bretagne Local phone: 09 72 67 50 29 (Frédéric Mescoff, head of the Operations Division Maintenance of the means of Production on the Ponant islands and Eric Laurent, ENEDIS territorial director.) **EDF Store & Forecast** Website: https://www.edf-sf.com/contact/ (developer of the EMS System on the island of Saint-Nicolas-des-Glénan)
Competent local authorities	*** Town hall of Fouesnant-Les-Glénan** Website: https://ville-fouesnant.fr/ Phone number: + 33 02 98 51 62 62 Email: contact@ville-fouesnant.fr Mayor: Roger Le Goff *** Association GLENANS AVENIR** Website: https://www.glenans-avenir.org/ Member of the association: Clémence Chapoutot Phone number: 07 69 29 24 33 Email: c.chapoutot@glenans.asso.fr
Contacts able to support the implementation innovative energy solutions by companies	*** Association Les Îles du Ponant (AIP)** Website: https://www.iles-du-ponant.com/contact/ Phone number: +33 (0)2 97 56 52 57 Emilie GAUTER (AIP Energy Officer) Phone number: 02 97 56 52 57 Email: emilie@iles-du-ponant.com *** Association SMILE** (project leader for intelligent energy networks) Coordinator SMILE Bretagne: Françoise Restif

	Email: f.restif@bdi.fr Phone number: 02 99 67 42 08 *** Entreprise Entech Smart Energies** Website: https://entech-se.com/entreprise/ Laurent Meyer, co-founder and managing director *** Entreprise Enag** Website: https://www.enag.fr/contact/ Henri Le Gallais, president of the Quimper company (specialized in the design and manufacture of energy conversion systems)
Research institutes and other contacts able to transmit elements to characterise renewable resources	*** CEREMA:** https://www.cerema.fr/fr/activites/services/gisements-potentiels-impacts-energies-marines-renouvelables https://www.cerema.fr/fr/activites/services/mesures-houle-acquisition-analyse-donnees *** Platform of meteoblue:** https://www.meteoblue.com/fr/meteo/historyclimate/climatemodelled *** SHOM (tidal energy from tides):** https://maree.shom.fr/harbor *** SHOM (tidal energy from current):** https://data.shom.fr/donnees *** MARC's model from IFREMER:** https://marc.ifremer.fr/resultats/vagues/modele_iroise *** PVGIS:** https://ec.europa.eu/jrc/en/pvgis *** Global Solar Atlas:** https://globalsolaratlas.info/map

Table 3 - Contacts for the Glénan

4.2. Île-de-Sein [France]

4.2.1 Island's presentation

Ile-de-Sein, an island commune in the department of Finistère in Brittany, is located 8 kilometres west of the French coast. This island has a population of 251 inhabitants according to INSEE data in December 2019 and a population density of 432.8 inhabitants/km², with a notable increase in the summer period. Ile-de-Sein is part of the Iroise Marine Natural Park and the Armorique Regional Natural Park.

Not connected to the mainland by a submarine cable, Ile-de-Sein is completely isolated electrically. Its energy production is mainly based on oil-fired thermal power generation. A powerful generator installed at the foot of the lighthouse, with an annual consumption of more than 400,000 litres of fuel oil, supplies most of the island's energy. This French commune also has photovoltaic (PV) panels with the solar power plant of the Ecloserie (86.6 kWp). In addition, there is a real desire on the part of the island to develop renewable energy sources on its territory in order to decarbonise its electricity production and diversify its energy mix. Its objective is to reach 100% renewable energy in the coming years. The island has a wide range of renewable resources, including wind, photovoltaic and marine energy.

4.2.2 Evaluation of electricity consumption

4.2.2.1 Electricity consumption on the island

The data below comes from the French government website which makes available local energy data since article 179 of the energy transition law for green growth (LTECV) of 17 August 2015.

First of all, we find the evolution of electricity consumption on the Ile-de-Sein between 2011 and 2018.

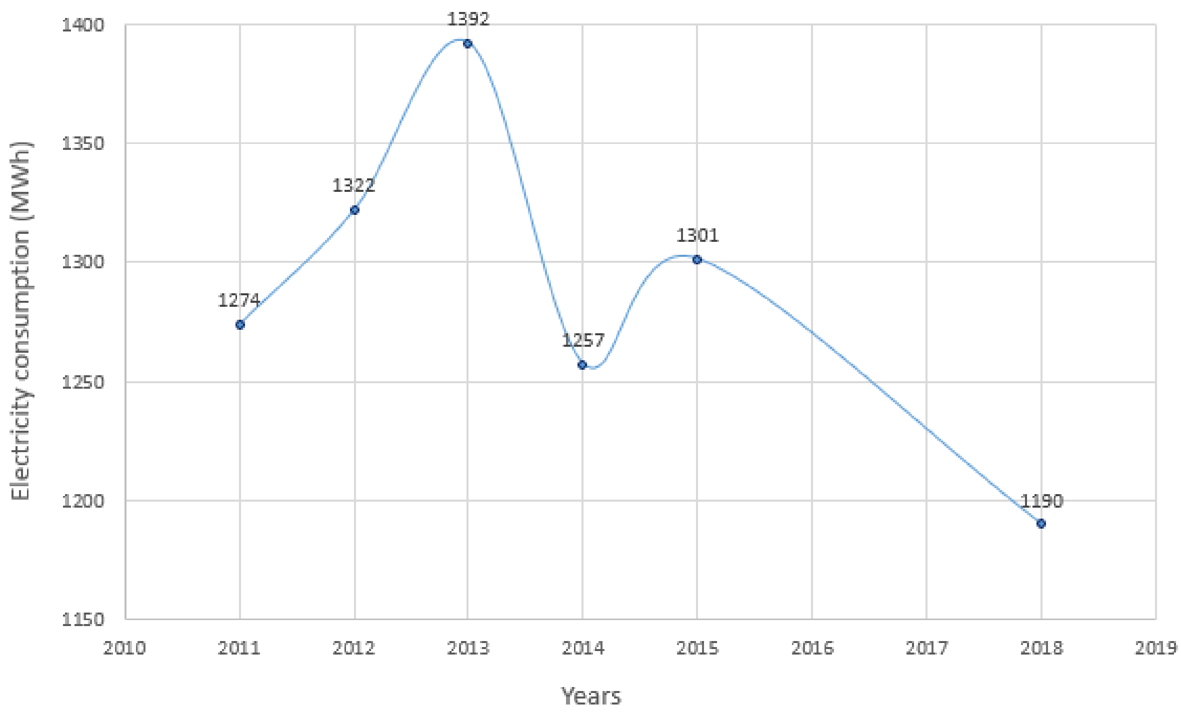


Figure 5 - Evolution of annual electricity consumption in Ile-de-Sein (2011-2018)

The island's electricity consumption peaked in 2013 to reach 1392 MWh consumed over the year and then gradually decreased until 2018 with a slight increase in 2015. These trends can be explained by the evolution of the population on the island based on INSEE data. In addition, from the years 2015-2016, measures have been put in place to reduce the island's energy consumption.

The following figure shows the evolution of electricity consumption on the island but highlights seasonal trends by sweeping the period from January 2017 to August 2019.

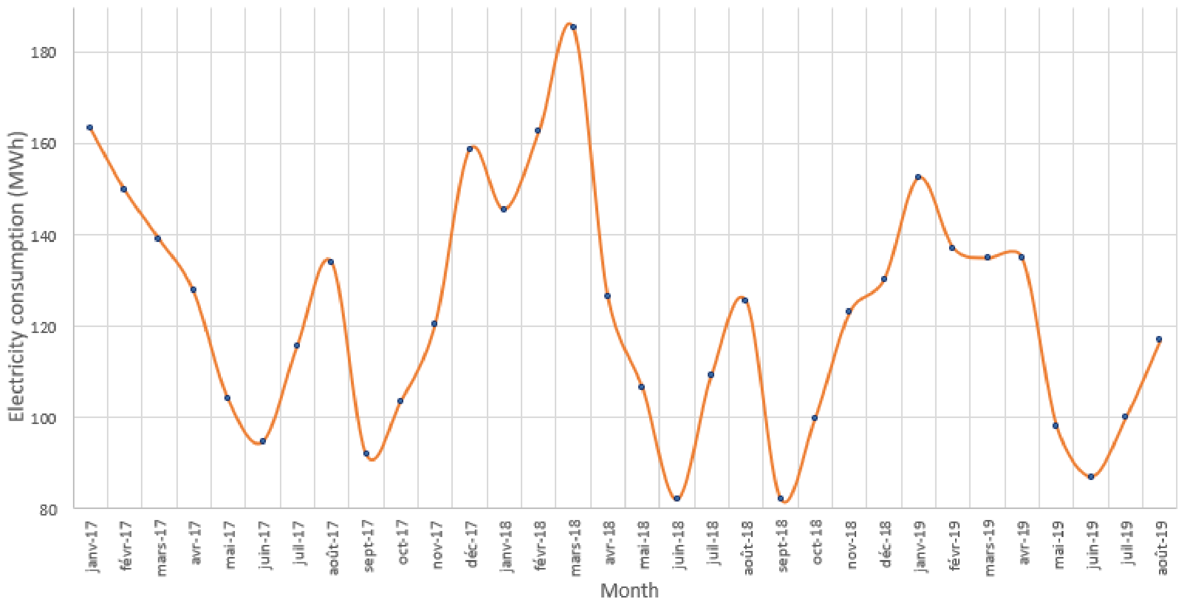


Figure 6 - Monthly electricity consumption in Ile-de-Sein (January 2017 - August 2019)

The consumption peaks are relatively numerous, and the consumption periods are rather broad. First, there is an increase in electricity consumption during the winter period, which covers the months of November to March. However, consumption peaks differ from one winter to another, as shown in the comparison between 2018 and 2019. In addition, there are also peaks in electricity consumption in summer, targeted in July and August and explainable by the waves of tourists who come to Île-de-Sein during this period. The lowest electricity consumption is therefore in June and September.

Data concerning electricity consumption on a daily scale were not provided or found. Nevertheless, the Ile-de-Sein town hall and the Association des Iles du Ponant have been contacted but these requests have not been followed up.

The following two figures show the power consumption according to the category of consumers. The first shows the evolution of this consumption according to the years, from 2011 to 2018.

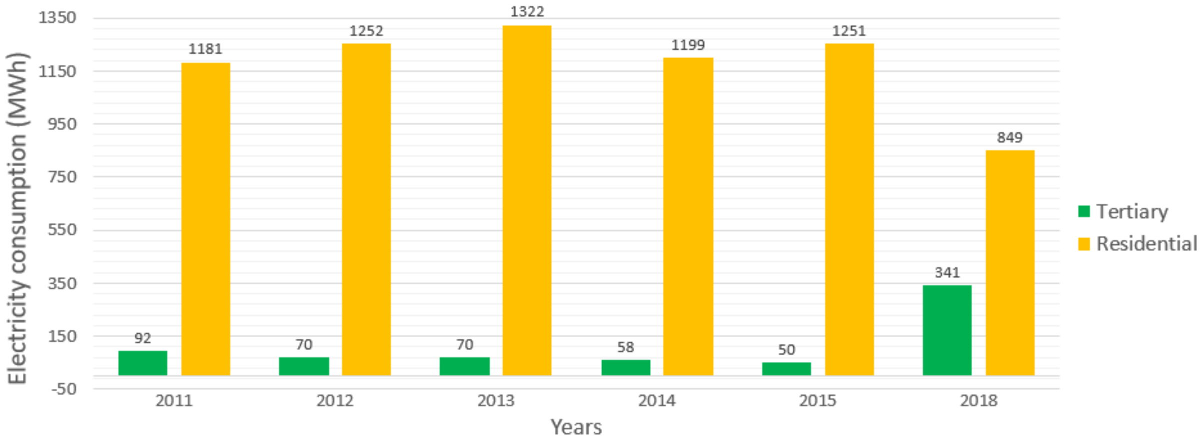


Figure 7 - Annual electricity consumption by sector of activity in Ile-de-Sein according to years (2011-2018)

Electricity consumption is mainly due to the residential sector. There will be a peak in consumption in the residential sector in 2013, which is in line with the figure showing the evolution of the island's total electricity consumption over the years. Nevertheless, in 2018, it can be observed that electricity consumption in the residential sector has decreased, which can be explained by the decrease in the number of inhabitants but also by the positive consequences of the policies carried out by the island in terms of energy transition. It is also noted that in 2018 the electricity consumption of the tertiary sector has increased significantly.

The second figure represents the proportion of each sector of activity in the island's electricity consumption for the year 2018. Unsurprisingly, the residential sector accounts for the largest share of electricity consumption with 71% followed by the tertiary sector with the remaining 29%.

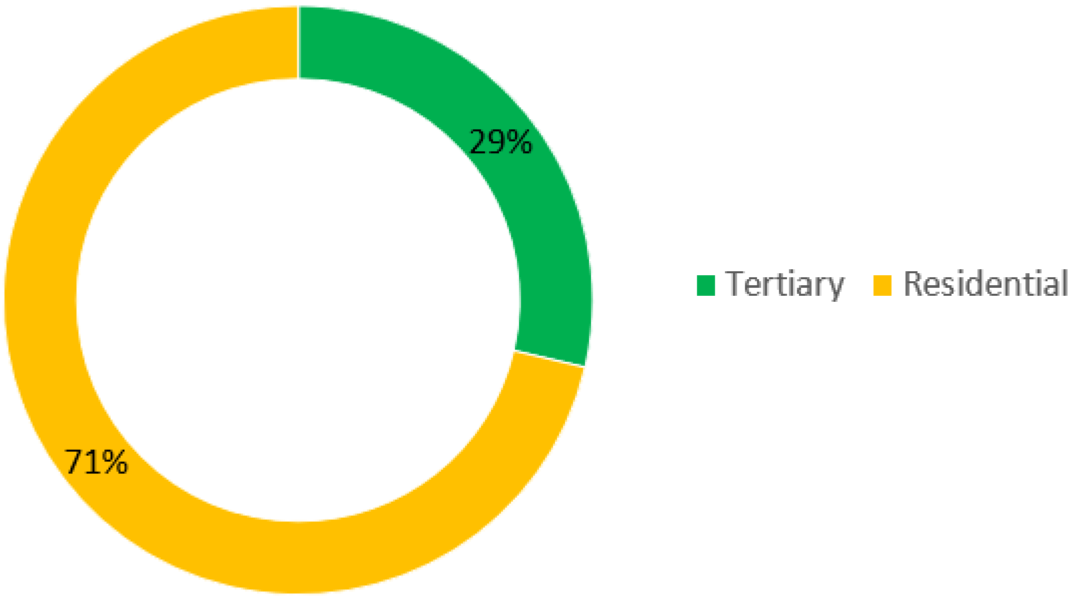


Figure 8 - Electricity consumption by sector of activity in 2018 on Île-de-Sein

4.2.2.2 Consumption patterns

The following section aims to present the consumption pattern of the Île-de-Sein. This pattern is also the same for the islands of Molène and Ushant as they are all part of the same energy transition programmes and their consumption patterns are similar. Therefore, elements on the islands of Molène and Ushant will also be presented in this section. First, the AIP (Association des Iles du Ponant) draws up an assessment of these three islands on its site. The least energy-efficient activities were quickly identified, and several measures were therefore taken. Indeed, energy-saving programmes have been put in place to reduce the volume of electricity consumed. They concerned the following points:

- Improvement of the energy performance of public buildings with work on insulation, replacement of door frames, programming, control and management of heating equipment,
- Dissemination of high-performance equipment for private individuals and professionals with the replacement of energy-consuming household appliances (refrigerators, freezers) and the distribution of LED bulbs,
- Upgrading of street lighting with LED bulbs as well,
- Habitat renovation for the three islands of Ushant, Molène and Sein,

Indeed, on this last point, under the impetus of the AIP and its partners (ANAH (National Housing Agency), Department of Finistère, ADEME, Brittany Region, EDF), a PIG (Public Interest Programme) was implemented from November 2012, the aim of which was to provide financial and technical support to owner-occupiers and landlords when carrying out energy-saving work in their homes. This programme ended on 31 December 2017, after 5 years of operation and more than 150 renovations carried out and supported in total on the three islands. Nevertheless, as the potential for energy savings linked to the heritage still remains significant, a new programme to support energy saving works, called RENOV'ÎLES, was set up by EDF SEI (financial support for the works) and AIP (operational implementation of the programme).

4.2.3 Evaluation of electricity production, transport and distribution means

4.2.3.1 Existing system

The following table presents the current electricity production system on Île-de-Sein.

	Île-de-Sein thermal power station	**Wind turbine**	**Photovoltaic panels**	**Energy Management System (EMS)**	**Centralised storage system**
Sector / power supply	Diesel	Wind	Solar	Energy optimisation software	Lithium-ion batteries

Producer	EDF	Finistère Habitat	SDEF	SDEF	Finistère Habitat	SDEF	SDEF	EDF-SEI	-
Site	-	Finistère Habitat accomodation	Nautical Centre	Hatchery	Finistère Habitat accomodation	SDIS Barracks	Maritime station	-	-
Date of commissioning	1990	2017	2016	2017	2017	2018	2018	2017	2017
Connecting power / Capacity	900 kW	7 kW	6 kWc	75 kWc	15 kWc	20 kWc	15 kWc	-	180 kWh

Table 4 - Existing electrical systems for Ile-de-Sein

For the moment, the island's thermal power plant accounts for the largest share of electricity production while consuming nearly 400,000 litres of fuel oil per year.

In addition, a wind power project piloted by EDF, and supported by the town hall, is in the operational study phase since September 2015 with the temporary installation of a meteorological measuring mast. Eventually, it includes the installation of one, then two wind turbines. A wind turbine would be installed initially, to demonstrate the technical feasibility of the project. The island is therefore eagerly awaiting the lifting of the regulatory hurdles, so that it can complete its project for a 35-metre 250 kW wind turbine, located near the lighthouse. This wind turbine alone would cover 50% of the island's electricity needs. This project could materialize quickly because the administrative court of Nantes confirmed the authorization of a building permit for the wind turbine in January 2020.

The total solar installations represent a power of 131 kWp. The EMS system makes it possible to stop the generator during periods of low consumption (mainly night and summer), to insert photovoltaic production and thus reduce CO2 emissions.

4.2.3.2 Evaluation of the market for innovative technologies

As explained in Johan Daelman's preliminary study, characterizing the Marine Renewable Energy (MRE) resource is an expert work generally attributed to research institutes. Having had a brief introduction to the different types of information needed to characterize renewable resources, the objective is now simply to identify the institutes able to provide this kind of data for different renewable resources with a strong interest in MRE. Where some information is provided by the institutes or other documentation, it will be presented to illustrate the summary table.

In addition, the research carried out in the framework of this study has made it possible to access a lot of information related to this part via studies already carried out, websites, scientific articles, etc. The results gathered and deemed relevant will also be presented to give the reader a more precise idea of the renewable energy potential of this NIA. The figures from the different institutes will be presented in the appendix for a better readability of the report.

The following summary table presents the institutes able to provide energy potential characterization data for each of the associated resources for the Île-de-Sein.

Resource Type	Institutes able to deliver resource characterization data
Tidal Energy from Tides	For France (and Europe to some extent), the tide directory of the French Navy's hydrographic and oceanographic service (SHOM - Service Hydrographique et Océanographique de la Marine) serves as a reference for a wide choice of ports.
Tidal Energy from Currents	The data portals of SHOM and the French Research Institute for Exploitation of the Sea (IFREMER - Institut français de recherche pour l'exploitation de la mer) have data on the intensity of surface and deep currents.
Wave Energy from Waves	IFREMER's MARC model is a good tool for obtaining a directional spectrum of the swell. In addition, CEREMA offers a service for the installation and operation of a wave measuring station.
Osmotic energy	The SHOM and IFREMER data portals are also to be queried first.
The thermal energy of the seas	
Wind energy	The Centre d'études et d'expertise sur les risques, l'environnement, la mobilité et l'aménagement (CEREMA) offers a service for assessing the potential deposits and impacts of marine renewable energies. The meteoblue platform shares local meteorological data for the whole world with a resolution of 30 km. In particular, wind roses are offered. For greater accuracy, they offer high-resolution simulations with hourly data.
Solar energy	The EU Joint Research Centre's solar modelling software, PVGIS, estimates the energy production potential that can be realised by photovoltaic solar technology on the basis of average solar irradiation for a given geographical location. The Global Solar Atlas also provides quick and easy access to data on solar resources around the world.

Table 5 - Presentation of the institutes providing renewable resource data for the Ile-de-Sein island

4.2.4 Evaluation of energy transition policies

4.2.4.1 Identification of local actors

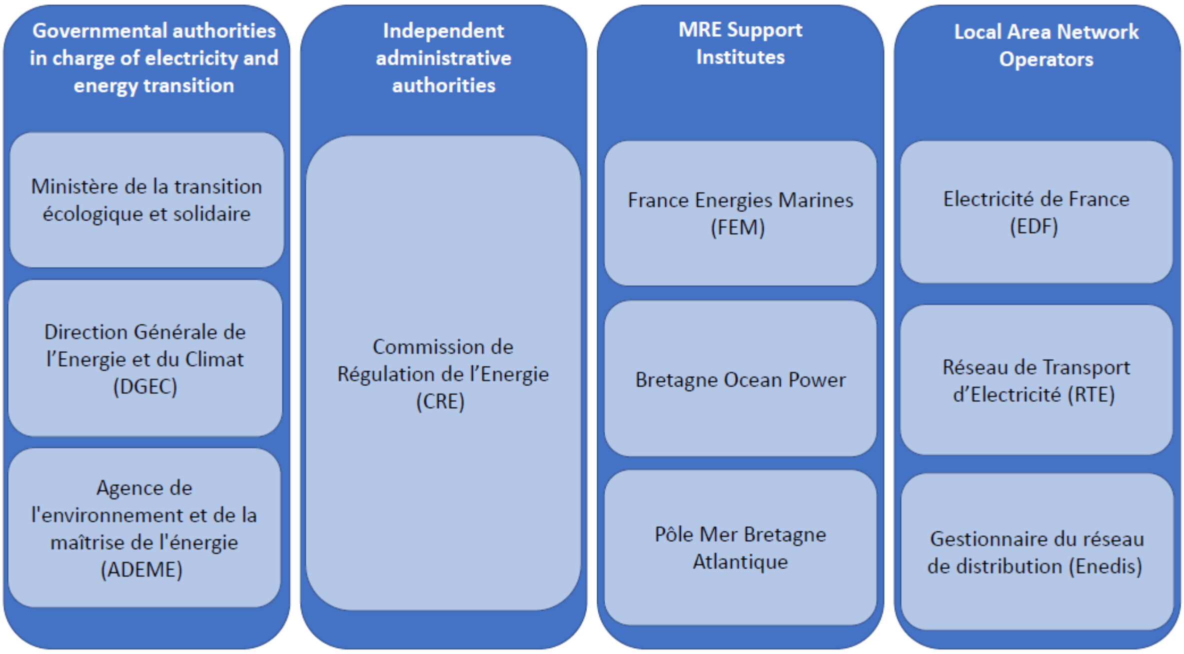


Figure 9 - Local actors of the Île-de-Sein

4.2.4.2 Identification of existing programmes and current energy transition policies

Aware of the climatic urgency and the need to free themselves as much as possible from fossil fuels, the Ile-de-Sein, Ushant and Molène islands have for some years now been undertaking an energy and ecological transition through several actions. Indeed, like any territory electrically isolated from the continental grid, CO2 emissions are much higher and dependence on thermal power stations that generally run on fuel oil is a real challenge to be met.

In collaboration with the Association des Iles du Ponant (AIP), these three islands have embarked on two ambitious projects from 2015 and 2016 to accelerate their energy transition. The objective for these islands is to achieve a 100% renewable energy electricity mix by 2030, while initially reducing greenhouse gas emissions.

Indeed, since 2015, the AIP is part of the regional project named Boucle Energétique Locale (BEL) meaning Local Energy Loop for the islands of Sein, Molène and Ushant. And since 2016, the national project Territoires à Energie Positive pour la Croissance Verte (TEPCV) (Positive Energy Territories for Green Growth) for all the Breton islands. As part of the TEPCV programme, some initiatives are supported by credits from the Energy Transition Financing Fund. 1.6 million in funding over three years have thus facilitated the process of this energy and ecological transition.

The AIP is supported in this ambitious programme by many institutional players such as Ademe (French Environment and Energy Management Agency), the Regional Council of Brittany, the Departmental Council of Finistère, but also by professional players such as EDF, Enedis and Sabella.

The initial results of these projects have been very encouraging. During the first assessment of the actions undertaken, while the initial objective of this first stage was an electrical energy saving of 753 MWh, the association announced that it amounted to 1,139 MWh with a reduction in fuel oil consumption of 386,700 litres in one year. As a result, the carbon footprint of the three islands has been greatly improved with carbon dioxide emissions falling by 16%.

To meet the objectives of this large project and to achieve green energy autonomy by 2030, the three islands have focused on the production of renewable energy based on wind, solar and tidal power.

Numerous photovoltaic panels have been installed. In Ushant, more than 290 square meters of solar panels now cover the roofs of the sports hall and multipurpose hall. The same approach has been taken in Sein, where 517 square meters of the hatchery are dedicated to the production of solar energy. Since 2017, the Ile-de-Sein also benefits from wind energy.

Moreover, Ushant island is benefiting from experimentation with the Sabella tidal turbine, an underwater turbine developed by the Quimper-based company Sabella. Between September 2015 and July 2016, during a first phase of experimentation in real conditions of use, it was immersed at a depth of 50 metres in Fromveur, one of the strongest sea currents in Europe: it produced more than 70 MWh of 100% renewable electricity for the inhabitants of the Ouessant island.

In addition to creating new means of renewable production, these islands have also developed the modernisation of the various electricity networks. In order to facilitate the integration of intermittent renewable energy sources such as solar and wind power, EDF has deployed Linky communicating meters as well as storage and grid management facilities. Indeed, the three islands have benefited from lithium-ion batteries to store energy.

Finally, energy-saving programmes have been set up to reduce the volume of electricity consumed by residents, including the distribution of LED light bulbs, the improvement of the energy efficiency of public buildings and the replacement of energy-intensive household appliances. Awareness-raising campaigns for visitors and residents to reduce energy consumption have also been undertaken.

Other projects are also under way to contribute to the transition of this energy mix. For example, an AIP-supported project aims to demonstrate the technical feasibility of electric mobility powered entirely by renewable energy on unconnected islands. To this end, it is considering autonomous recharging stations with renewable energy production dedicated to the consumption of electric vehicles or recharging stations controlled by the periods of injection of renewable energy into the electricity grid.

These three islands are also involved in more local projects with:

- The "PHARES" project (Progressive hybrid architecture for renewable energy solutions in islands) for Ushant which is composed of a hydro, wind, photovoltaic and storage capacity component. This project aims to demonstrate the relevance of a hybrid energy model in an island context.
- Experimentation of off-peak/peak hours in Ushant: this project led by EDF SEI, Enedis and AIP aims to promote the integration of renewable energies at the peak of their production.
- The "Rénov'îles" programme on Sein, Molène and Ushant, which involves support for energy-saving work by EDF SEI and AIP.

4.2.4.3 Assessment of the relevance of ongoing programmes and projects

The programmes and projects undertaken for the three islands of Ile-de-Sein, Ushant and Molène have been in progress for several years now. Nevertheless, these three islands have set themselves the goal of achieving 100% energy self-sufficiency through renewable energies by 2030 and at present this goal has still not been achieved. Generating sets are still present on the islands.

There is therefore enormous potential for companies working in the energy transition because local and regional authorities and the island population are very much involved in achieving this objective and any innovative project will obviously be beneficial. These islands are real test laboratories for an energy and ecological transition and all the means implemented have the same objective of 100% renewable energy. Moreover, the intermittent nature of renewable energy sources, particularly wind and solar energy, could thus encourage the consideration of other sources of renewable energy, particularly MRE, in the light of the abundant and high-potential marine resources that coexist with these islands.

4.2.5 Contacts

Contacts for electricity supply and power grid management	* Producer of electricity: **EDF** (Electricité De France) Website: https://www.edf.fr/contacts/institutionnels Local phone : 09 69 32 15 15 * Electricity Distribution System Operator: **ENEDIS** Website: https://www.enedis.fr/enedis-en-bretagne Local phone: 09 72 67 50 29 (Frédéric Mescoff, head of the Operations Division Maintenance of the means of Production on the Ponant islands and Eric Laurent, ENEDIS territorial director.)
Competent local authorities	*** Town hall of Île-de-Sein** Phone number: + 33 02 98 70 90 35 Email: mairie.ile.de.sein@orange.fr Websites: http://www.mairie-iledesein.com http://www.ilesein.com/
Contacts able to support the implementation innovative energy solutions by companies	*** Association Les Îles du Ponant (AIP)** Website: https://www.iles-du-ponant.com/contact/ Phone number: +33 (0)2 97 56 52 57 Emilie GAUTER (AIP Energy Officer) Phone number: 02 97 56 52 57 Email: emilie@iles-du-ponant.com *** Company Île de Sein Energies (IDSE)** Website: http://www.idsenergies.fr Phone number : 02 99 06 80 11

Research institutes and other contacts able to transmit elements to characterise renewable resources	*** CEREMA:** https://www.cerema.fr/fr/activites/services/gisements-potentiels-impacts-energies-marines-renouvelables https://www.cerema.fr/fr/activites/services/mesures-houle-acquisition-analyse-donnees *** Platform of meteoblue:** https://www.meteoblue.com/fr/meteo/historyclimate/climatemodelled *** SHOM (tidal energy from tides):** https://maree.shom.fr/harbor *** SHOM (tidal energy from current):** https://data.shom.fr/donnees *** MARC's model from IFREMER:** https://marc.ifremer.fr/resultats/vagues/modele_iroise *** PVGIS:** https://ec.europa.eu/jrc/en/pvgis *** Global Solar Atlas:** https://globalsolaratlas.info/map

Table 6 - Contacts for the Île-de-Sein

4.3. Island of Molène [France]

4.3.1 Island's presentation

The island of Molène, an island commune in the department of Finistère in Brittany, is located 14 kilometres west of the French coast and about ten kilometres from the neighbouring island of Ouessant. This island has a population of 146 inhabitants according to INSEE data in December 2019 and a population density of 202.8 inhabitants/km², with a notable increase in the summer period.

Not connected to the mainland by a submarine cable, the island of Molène is completely electrically insulated. Its energy production is mainly based on oil-fired thermal power generation. The island has three generators of 150, 225 and 320 kVA, which represents a production capacity of 695 kW. Nevertheless, these generators consume more than 394,000 litres of fuel oil per year. This French commune also has a few photovoltaic (PV) panels, notably on the Ledenez seaweed boat building and the EDF fuel oil plant building. In addition, there is a real desire on the part of the island to develop renewable energy sources on its territory in order to decarbonise its electricity production and diversify its energy mix. Its objective is to reach 100% renewable energy in the coming years. The island has a wide range of renewable resources, including wind, photovoltaic and marine energy.

4.3.2 Evaluation of electricity consumption

4.3.2.1 Electricity consumption on the island

The data below comes from the French government website which makes available local energy data since article 179 of the energy transition law for green growth (LTECV) of 17 August 2015.

First, we find the evolution of electricity consumption on the island of Molène between 2011 and 2018.

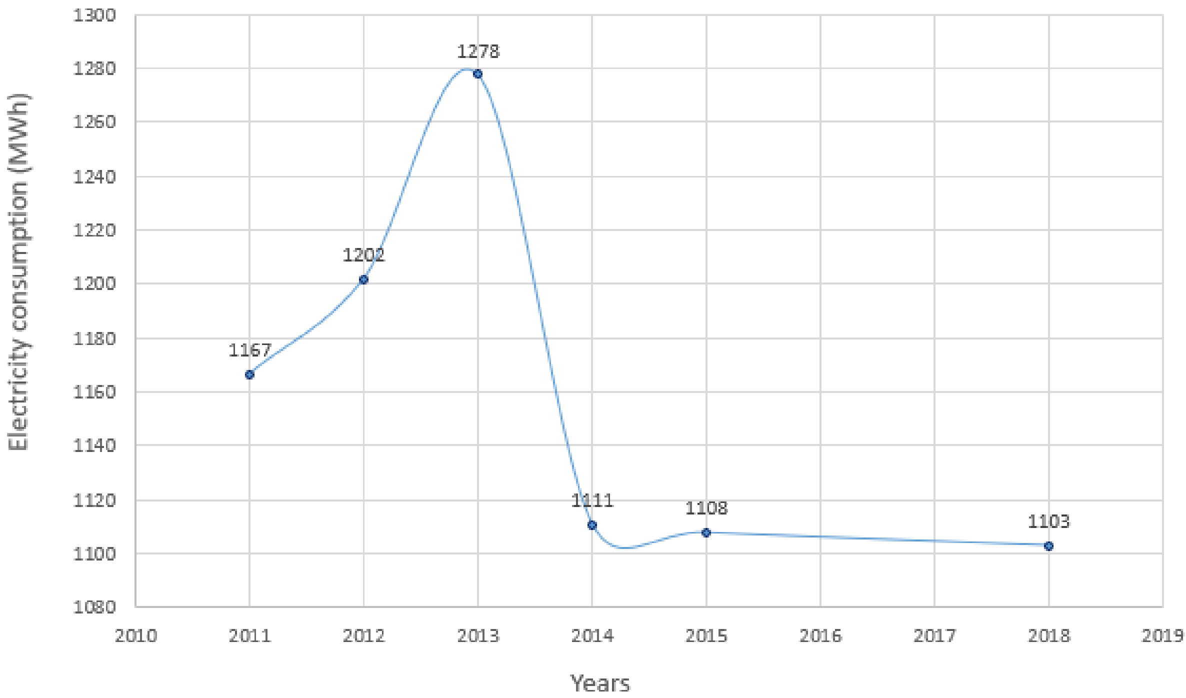


Figure 10 - Evolution of annual electricity consumption on the island of Molène (2011-2018)

The island's consumption peaked in 2013 to reach 1278 MWh consumed over the year and then fell sharply to stabilise after 2014. The increase in consumption can be explained by the increase in population on the island over this period, based on INSEE data. In addition, from the years 2015-2016, measures have been put in place to reduce the island's energy consumption.

The following figure shows the evolution of electricity consumption on the island but highlights seasonal trends by sweeping the period from January 2017 to August 2019.

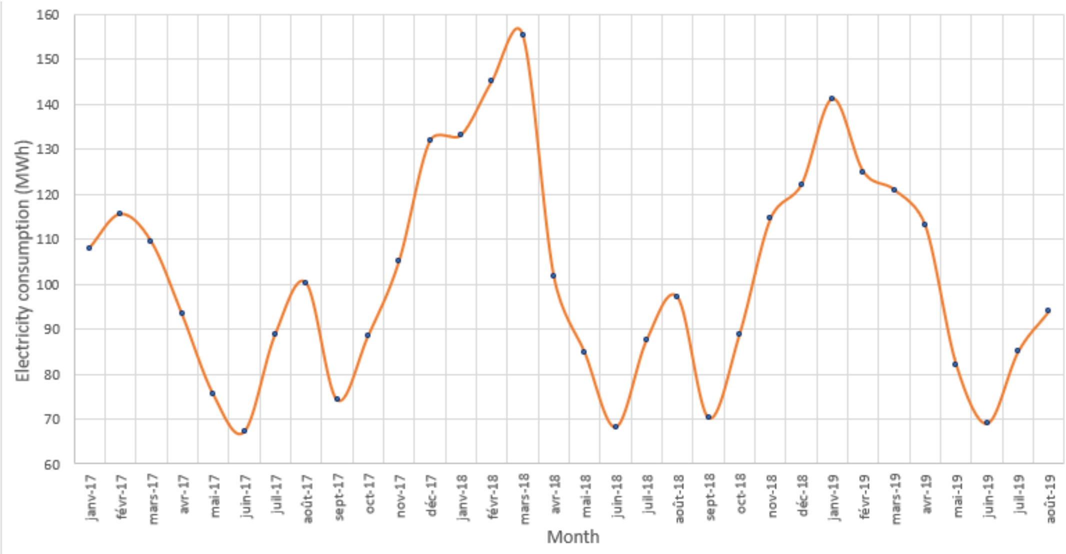


Figure 11 - Evolution of monthly electricity consumption on the island of Molène (January 2017 - August 2019)

Peaks in consumption are relatively numerous and the consumption periods are rather wide, especially in winter. First of all, there is an increase in electricity consumption during the winter period, which covers the months of December to March. However, consumption peaks are different from one winter to another, as shown by the winter of 2017 compared to the following two winters. In addition, as on Île-de-Sein, there are also peaks in electricity consumption in summer, targeted in July and August and explained by the waves of tourists who come to Île de Molène during this summer period. The lowest electricity consumption is in June.

Data concerning electricity consumption on a daily scale have not been provided or found. Nevertheless, the town hall of the island of Molène and the Association of the Ponant Islands have been contacted but these requests have not been followed up.

The following two figures show the power consumption according to the category of consumers. The first shows the evolution of this evolution according to the years, from 2011 to 2018.

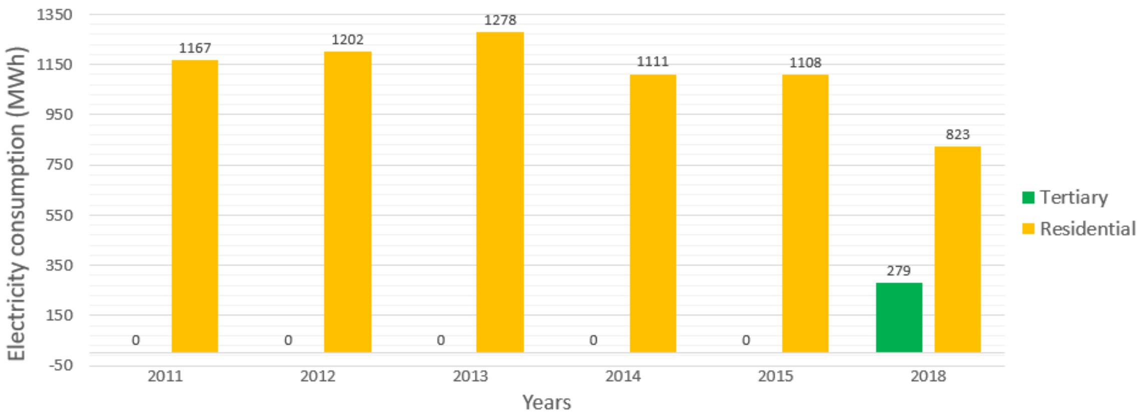


Figure 12 - Annual electricity consumption by sector of activity on the island of Molène (2011-2018)

Electricity consumption is almost entirely due to the residential sector. There will be a peak in consumption in the residential sector in 2013, which is in line with the figure showing the evolution of the island's total electricity consumption over the years. Nevertheless, from 2014 onwards, electricity consumption in the residential sector declines, which is confirmed in 2018 with a clear decrease. This can be explained by the decrease in the number of inhabitants but also by the positive consequences of the policies carried out by the island in terms of energy transition. We also note the appearance in 2018 of a share of electricity consumption linked to the tertiary sector.

The second figure represents the proportion of each sector of activity in the island's electricity consumption for the year 2018. The residential sector participates in the largest share of electricity consumption with 75% but the tertiary sector, which was non-existent since 2018, nevertheless represents a considerable share in this distribution.

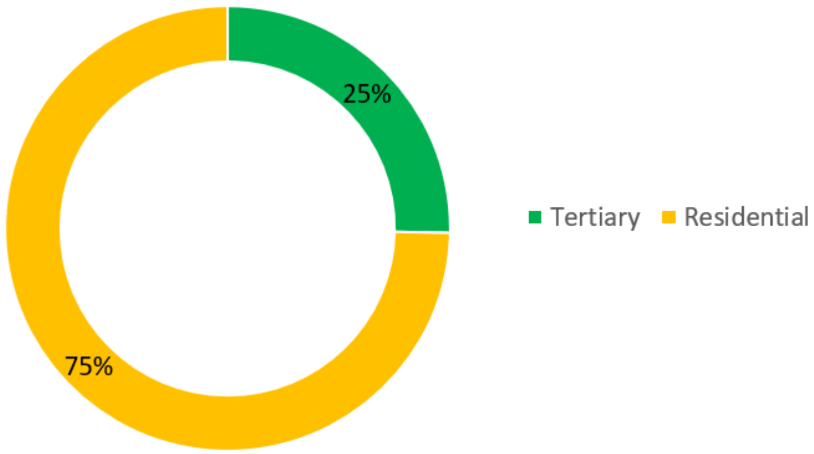


Figure 13 - Electricity consumption by sector of activity in 2018 on the island of Molène

4.3.2.2 Consumption patterns

The consumption pattern of the Ile de Molène is the same as that of the Ile-de-Sein in terms of measures taken concerning the least energy-efficient activities. This part is therefore developed in the corresponding part of the Ile-de-Sein.

4.3.3 Evaluation of electricity production, transport and distribution means

4.3.3.1 Existing system

The following table shows the current electricity production system on the island of Molène. The thermal power plant accounts for the largest share of electricity production but nevertheless consumes 394,000 litres of fuel oil per year.

	Molène Island Thermal Power Plant	Photovoltaic panels	
Sector / power supply	Diesel	Solar	Solar
Producer	EDF	SDEF	SDEF
Site	-	Ledenez's seaweed ship buildings	EDF fuel oil plant building
Date of commissioning	1970	2017	After 2017
Connecting power / Capacity	695 kW	5.88 kWc	13 kWc

Table 7 - Existing electrical systems for the island of Molène

4.3.3.2 Evaluation of the market for innovative technologies

As explained in Johan Daelman's preliminary study, characterizing the Marine Renewable Energy (MRE) resource is an expert work generally attributed to research institutes. Having had a brief introduction to the different types of information needed to characterize renewable resources, the objective is now simply to identify the institutes able to provide this kind of data for different renewable resources with a strong interest in MRE. Where some information is provided by the institutes or other documentation, it will be presented to illustrate the summary table.

In addition, the research carried out in the framework of this study has made it possible to access a lot of information related to this part via studies already carried out, websites, scientific articles, etc. The results gathered and deemed relevant will also be presented to give the reader a more precise idea of the renewable energy potential of this NIA. The figures from the different institutes will be presented in the appendix for a better readability of the report.

The following summary table presents the institutes able to provide characterisation data on the energy potential for each of the associated resources for the island of Molène.

Resource Type	Institutes able to deliver resource characterization data
Tidal Energy from Tides	For France (and Europe to some extent), the tide directory of the French Navy's hydrographic and oceanographic service (SHOM - Service Hydrographique et Océanographique de la Marine) serves as a reference for a wide choice of ports.

Tidal Energy from Currents	The data portals of SHOM and the French Research Institute for Exploitation of the Sea (IFREMER - Institut français de recherche pour l'exploitation de la mer) have data on the intensity of surface and deep currents.
Wave Energy from Waves	IFREMER's MARC model is a good tool for obtaining a directional spectrum of the swell. In addition, CEREMA offers a service for the installation and operation of a wave measuring station.
Osmotic energy	The SHOM and IFREMER data portals are also to be queried first.
The thermal energy of the seas	
Wind energy	The Centre d'études et d'expertise sur les risques, l'environnement, la mobilité et l'aménagement (CEREMA) offers a service for assessing the potential deposits and impacts of marine renewable energies. The meteoblue platform shares local meteorological data for the whole world with a resolution of 30 km. In particular, wind roses are offered. For greater accuracy, they offer high-resolution simulations with hourly data.
Solar energy	The EU Joint Research Centre's solar modelling software, PVGIS, estimates the energy production potential that can be realised by photovoltaic solar technology on the basis of average solar irradiation for a given geographical location. The Global Solar Atlas also provides quick and easy access to data on solar resources around the world.

Table 8 - Presentation of the institutes providing renewable resource data for the island of Molène

4.3.4 Evaluation of energy transition policies

As the islands of Sein, Molène and Ushant have the same energy transition policies, this part is described in the section "Evaluation of energy transition policies" of the Ile-de-Sein (part 4.2).

4.3.5 Contacts

Contacts for electricity supply and power grid management	* Producer of electricity: **EDF** (Electricité De France) Website: https://www.edf.fr/contacts/institutionnels Local phone : 09 69 32 15 15 * Electricity Distribution System Operator: **ENEDIS** Website: https://www.enedis.fr/enedis-en-bretagne

	Local phone: 09 72 67 50 29 (Frédéric Mescoff, head of the Operations Division Maintenance of the means of Production on the Ponant islands and Eric Laurent, ENEDIS territorial director.)
Competent local authorities	*** Town hall of Île de Molène** Phone number: + 33 02 98 07 39 0 Email: mairie.ile.molene@wanadoo.fr Website: http://www.molene.fr
Contacts able to support the implementation innovative energy solutions by companies	*** Association Les Îles du Ponant (AIP)** Website: https://www.iles-du-ponant.com/contact/ Phone number: +33 (0)2 97 56 52 57 Emilie GAUTER (AIP Energy Officer) Phone number: 02 97 56 52 57 Email: emilie@iles-du-ponant.com
Research institutes and other contacts able to transmit elements to characterise renewable resources	*** CEREMA:** https://www.cerema.fr/fr/activites/services/gisements-potentiels-impacts-energies-marines-renouvelables https://www.cerema.fr/fr/activites/services/mesures-houle-acquisition-analyse-donnees *** Platform of meteoblue:** https://www.meteoblue.com/fr/meteo/historyclimate/climatemodelled *** SHOM (tidal energy from tides):** https://maree.shom.fr/harbor *** SHOM (tidal energy from current):** https://data.shom.fr/donnees *** MARC's model from IFREMER:** https://marc.ifremer.fr/resultats/vagues/modele_iroise *** PVGIS:** https://ec.europa.eu/jrc/en/pvgis *** Global Solar Atlas:** https://globalsolaratlas.info/map

Table 9 - Contacts for Molène

4.4. Ushant Island - Île d'Ouessant [France]

4.4.1 Island's presentation

Ushant Island, an island commune in the department of Finistère in Brittany, is located 20 kilometres west of the French coast and about ten kilometres from the neighbouring island of Molène. This island has a population of 854 inhabitants according to INSEE data in December 2019 and a population density of 54.81 inhabitants/km², with a notable increase in the summer period.

Not connected to the mainland by a submarine cable, Ushant Island is completely electrically insulated. Its energy production is mainly based on oil-fired thermal power generation, the cost price per kilowatt being between two and four times higher than on the mainland. The Ushant thermal power plant is equipped with two 1,200 kVA and two 1,450 kVA generators, which represents a production capacity of 5.3 MW. Nevertheless, these generators consume more than 1.8 million litres of fuel oil per year. This French municipality also has photovoltaic (PV) panels, uses solar thermal energy to produce hot water and is experimenting with the Sabella D10 tidal turbine, which develops 1 MW of power. In addition, there is a real desire on the part of the island to develop renewable energy sources on its territory in order to decarbonise its electricity production and diversify its energy mix. Indeed, it aims to reach 100% renewable energy in the coming years. Indeed, the island has a wide range of renewable resources with wind, photovoltaic, solar thermal and marine energy.

4.4.2 Evaluation of electricity consumption

4.4.2.1 Electricity consumption on the island

The data below comes from the French government website which makes available local energy data since article 179 of the energy transition law for green growth (LTECV) of 17 August 2015.

First, we find the evolution of electricity consumption on the Ushant island between 2011 and 2018.

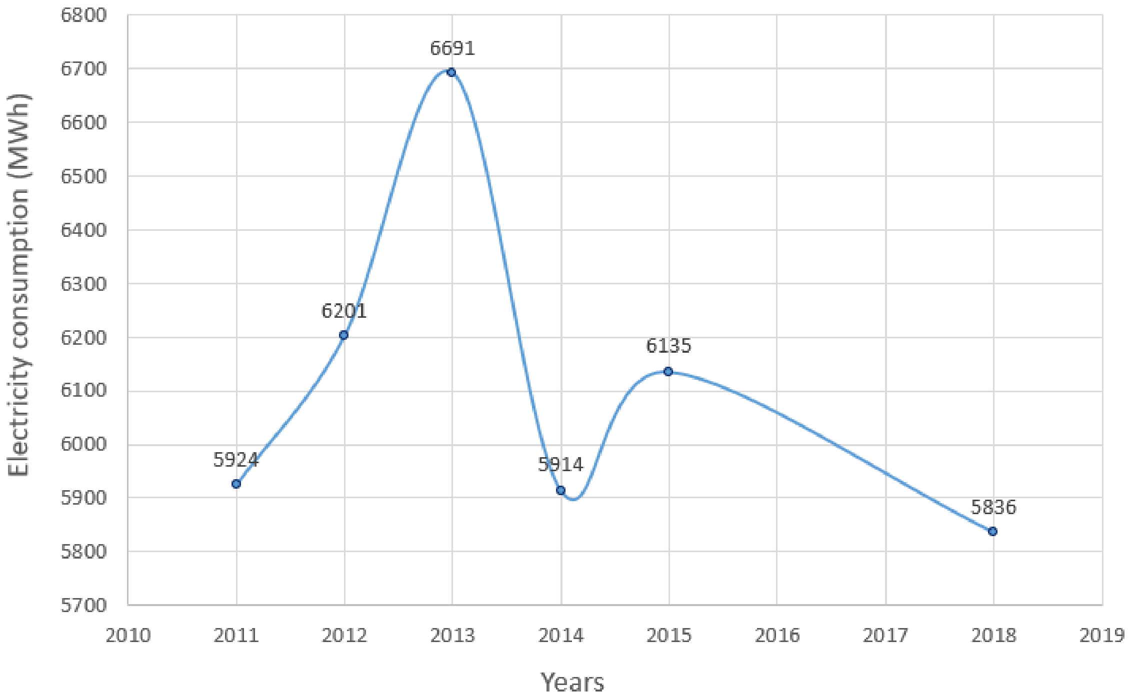


Figure 14 - Evolution of annual electricity consumption on the island of Ouessant (2011 - 2018)

The island's consumption peaked in 2013 to reach 6691 MWh consumed over the year and then gradually decreased until 2018 with a slight increase in 2015. These trends can be explained by the evolution of the population on the island which follows the same trends according to INSEE data. In addition, from the years 2015-2016, measures have been put in place to reduce the island's energy consumption.

The following figure shows the evolution of electricity consumption on the island but highlights seasonal trends by sweeping the period from January 2017 to August 2019.

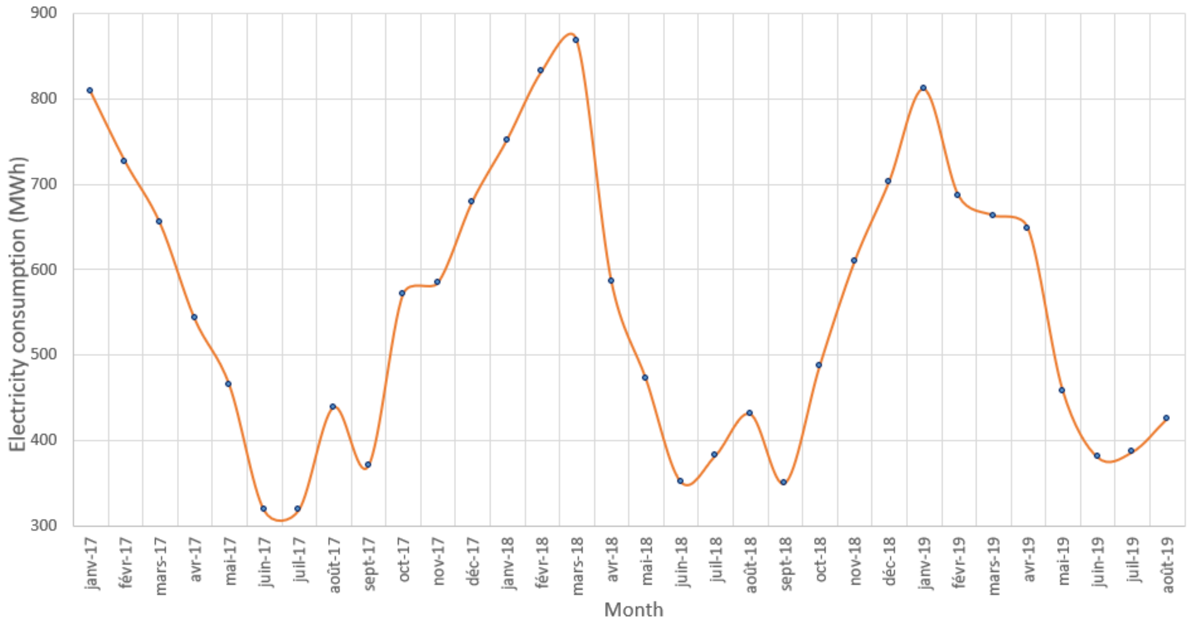


Figure 15 - Evolution of monthly electricity consumption on the island of Ouessant (January 2017 - August 2019)

Peaks in consumption are found in winter, between December and March, while the lowest consumption occurs in summer between June and July and even until September for the year 2018.

Data concerning electricity consumption on a daily scale were not provided or found. Nevertheless, the town hall of Ushant Island and the Association des Iles du Ponant have been contacted but these requests have not been followed up.

The following two figures show the power consumption according to the category of consumers.

The first shows the evolution of this evolution according to the years, from 2011 to 2018. Electricity consumption is mainly due to the residential sector. There is a peak in consumption in the residential sector in 2013, which is in line with the figure showing the evolution of the island's total electricity consumption as a function of the years. Nevertheless, in 2018, it can be observed that electricity consumption in the residential sector has decreased, which can be explained by the decrease in the number of inhabitants but also by the positive consequences of the policies carried out by the island in terms of energy transition. It is also noted that in 2018 the electricity consumption of the tertiary sector has increased significantly.

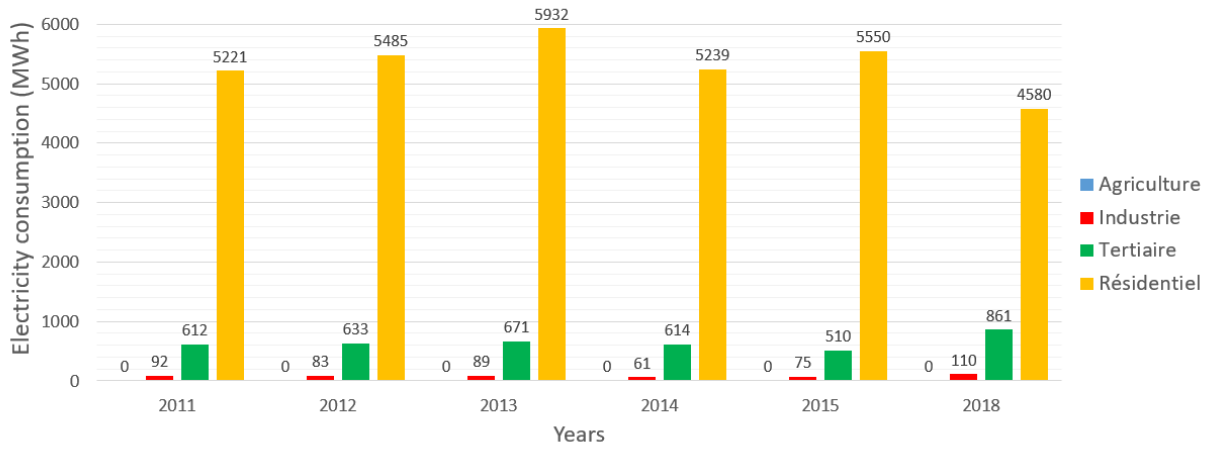


Figure 16 - Annual electricity consumption by sector of activity on Ushant Island (2011-2018)

The second figure represents the proportion of each sector of activity in the island's electricity consumption for the year 2018. Unsurprisingly, the residential sector accounts for the largest share of electricity consumption, followed by the tertiary sector and then the industrial sector. It should also be noted that despite the island's large size, agriculture does not contribute to the island's electricity consumption.

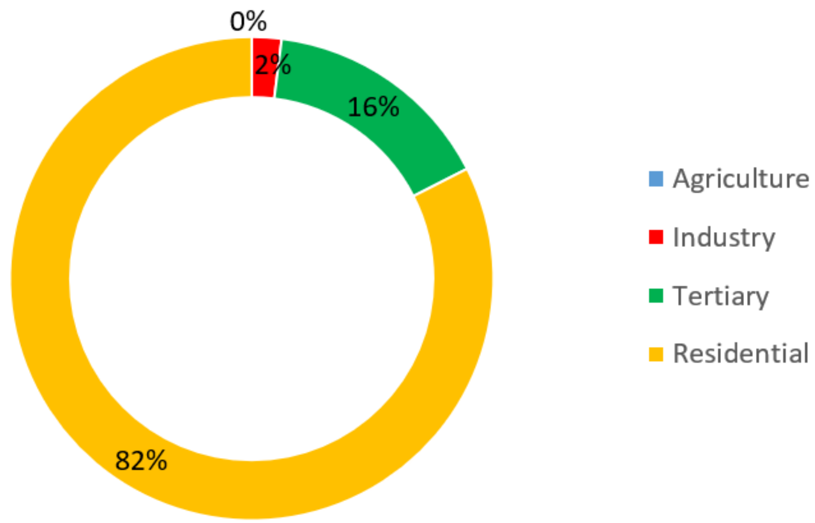


Figure 17 - Electricity consumption by sector of activity in 2018 on Ushant Island

4.4.2.2 Consumption patterns

The consumption pattern of Ushant Island is the same as that of Ile-de-Sein in terms of the measures taken concerning the least energy-efficient activities. This part is therefore developed at the level of the île-de-Sein in the corresponding section.

4.4.3 Evaluation of electricity production, transport and distribution means

4.4.3.1 Existing system

The following table shows the current power generation system on Ushant Island.

	Ushant Island Thermal Power Plant	**Photovoltaic panels**	**Energy Management System (EMS)**	**Centralised storage system**	**Tidal turbines farm**
Sector / power supply	Diesel	Solar	Energy optimisation software	Lithium-ion batteries (2 containers)	Tidal
Producer	EDF	SDEF	EDF-SEI	-	Sabella
Site	Centre of the town	Sports hall, multi-purpose hall, campsite and barracks	-	Centre of the town	South West of Ushant Island
Date of commissioning	2005	From 2017	2017	2017	Sabella D10 in 2018
Connecting power / Capacity	5300 kW	At least 50 kWc	-	1 MW and 500 kW	1 MW

Table 10 - Existing electrical systems for Ushant island

For the moment, the island's thermal power plant accounts for the largest share of electricity production but consumes 1,890,000 litres of fuel oil per year.

In addition, a project to combine wind, hydro and solar energy is under way with a coupling to a storage system. Indeed, the energy produced will come from two tidal turbines developed by the Quimper company Sabella, a 900 kW wind turbine which will make it possible to smooth out consumption peaks, and an innovative photovoltaic solar mix, developed by Akuo Energy, which will provide 500 kW to supply the additional energy needed during the summer period. The project should then give rise to France's first commercial tidal turbine farm. The project's storage capacity will be 2 MWh. In addition, the 67 m high wind turbine would be installed at the site of the previous one, or at Penn ar Roc'h, the choice will depend on landscape, acoustic and radar studies. However, this installation should be simplified by the Elan bill for small territories such as islands. This initiative, worth a total of 25 million euros, is supported by the Brittany region and the ADEME (French Environment and Energy Management Agency) Future Investment Programme.

4.4.3.2 Evaluation of the market for innovative technologies

As explained in Johan Daelman's preliminary study, characterizing the Marine Renewable Energy (MRE) resource is an expert work generally attributed to research institutes. Having had a brief introduction to the different types of information needed to characterize renewable resources, the objective is now simply to identify the institutes able to provide this kind of data for different renewable resources with a strong interest in MRE. Where some information is provided by the institutes or other documentation, it will be presented to illustrate the summary table.

In addition, the research carried out in the framework of this study has made it possible to access a lot of information related to this part via studies already carried out, websites, scientific articles, etc. The results gathered and deemed relevant will also be presented to give the reader a more precise idea of the renewable energy potential of this NIA. The figures from the different institutes will be presented in the appendix for a better readability of the report.

The following summary table presents the institutes able to provide characterisation data on the energy potential for each of the associated resources for Ushant Island.

Resource Type	**Institutes able to deliver resource characterization data**
Tidal Energy from Tides	For France (and Europe to some extent), the tide directory of the French Navy's hydrographic and oceanographic service (SHOM - Service Hydrographique et Océanographique de la Marine) serves as a reference for a wide choice of ports.
Tidal Energy from Currents	The data portals of SHOM and the French Research Institute for Exploitation of the Sea (IFREMER - Institut français de recherche pour l'exploitation de la mer) have data on the intensity of surface and deep currents.
Wave Energy from Waves	IFREMER's MARC model is a good tool for obtaining a directional spectrum of the swell. In addition, CEREMA offers a service for the installation and operation of a wave measuring station.
Osmotic energy	The SHOM and IFREMER data portals are also to be queried first.
The thermal energy of the seas	
Wind energy	The Centre d'études et d'expertise sur les risques, l'environnement, la mobilité et l'aménagement (CEREMA) offers a service for assessing the potential deposits and impacts of marine renewable energies. The meteoblue platform shares local meteorological data for the whole world with a resolution of 30 km. In particular, wind roses are offered. For greater accuracy, they offer high-resolution simulations with hourly data.

Solar energy	The EU Joint Research Centre's solar modelling software, PVGIS, estimates the energy production potential that can be realised by photovoltaic solar technology on the basis of average solar irradiation for a given geographical location. The Global Solar Atlas also provides quick and easy access to data on solar resources around the world.

Table 11 - Presentation of the institutes providing renewable resource data for Ushant island

4.4.4 Evaluation of energy transition policies

As the islands of Sein, Molène and Ushant have the same energy transition policies, this part is described in the section "Evaluation of energy transition policies" of the Ile-de-Sein (part 4.2).

4.4.5 Contacts

Contacts for electricity supply and power grid management	* Producer of electricity: **EDF** (Electricité De France) Website: https://www.edf.fr/contacts/institutionnels Local phone : 09 69 32 15 15 * Electricity Distribution System Operator: **ENEDIS** Website: https://www.enedis.fr/enedis-en-bretagne Local phone: 09 72 67 50 29 (Frédéric Mescoff, head of the Operations Division Maintenance of the means of Production on the Ponant islands and Eric Laurent, ENEDIS territorial director.) *Electricity carrier: **RTE** (Réseau de Transport d'Electricité) Website: https://www.rte-france.com/fr Phone: +33 2 98 66 60 00 *SDEF Gwendal Vonk (Energy Policy Officer) Mail: gwendal.vonk@sdef.fr Phone: 06 62 75 18 04
Competent local authorities	*** Town hall of Île d'Ouessant** Phone number: + 33 02 98 48 80 06 Email: mairie.eusa@wanadoo.fr Websites: http://www.mairie-ouessant.fr http://www.ouessant.fr/ Mayor: Denis PALLUEL
Contacts able to support the implementation	*** Association Les Îles du Ponant (AIP)** Website: https://www.iles-du-ponant.com/contact/

innovative energy solutions by companies	Phone number: +33 (0)2 97 56 52 57 Emilie GAUTER (AIP Energy Officer) Phone number: 02 97 56 52 57 Email: emilie@iles-du-ponant.com *** SABELLA SAS** Website: https://www.sabella.bzh/fr Phone number: 02 98 10 12 35 Email: contact@sabella.bzh
Research institutes and other contacts able to transmit elements to characterise renewable resources	*** CEREMA:** https://www.cerema.fr/fr/activites/services/gisements-potentiels-impacts-energies-marines-renouvelables https://www.cerema.fr/fr/activites/services/mesures-houle-acquisition-analyse-donnees *** Platform of meteoblue:** https://www.meteoblue.com/fr/meteo/historyclimate/climatemodelled *** SHOM (tidal energy from tides):** https://maree.shom.fr/harbor *** SHOM (tidal energy from current):** https://data.shom.fr/donnees *** MARC's model from IFREMER:** https://marc.ifremer.fr/resultats/vagues/modele_iroise *** PVGIS:** https://ec.europa.eu/jrc/en/pvgis *** Global Solar Atlas:** https://globalsolaratlas.info/map

Table 12 - Contacts for Ushant Island

4.5. Islands of Chausey - Grande île, Archipel des Chausey [France]

4.5.1 Island's presentation

Grande île is in the English Channel, opposite Granville (17 kilometres) in Normandy. This island is inhabited by 30 inhabitants all year round, with a density of 10 inhabitants/km² and welcomes 200,000 people during the summer season. This French island is attached to the Normandy region.

There is no submarine cable connection with the mainland, so the island is completely electrically insulated. To supply itself with electricity, the island relies on four fuel-powered generators, and therefore must import 180,000 litres of fuel per year. The consumption on the island is 532MWh per year. This French commune has chosen to change its electricity production to turn to renewable energy. Indeed, this island, belonging to the Natura 2000 network, has set itself the objective of being 100% renewable by 2030, and this by installing solar panels on the island or by using fuel cells.

4.5.2 Evaluation of electricity consumption

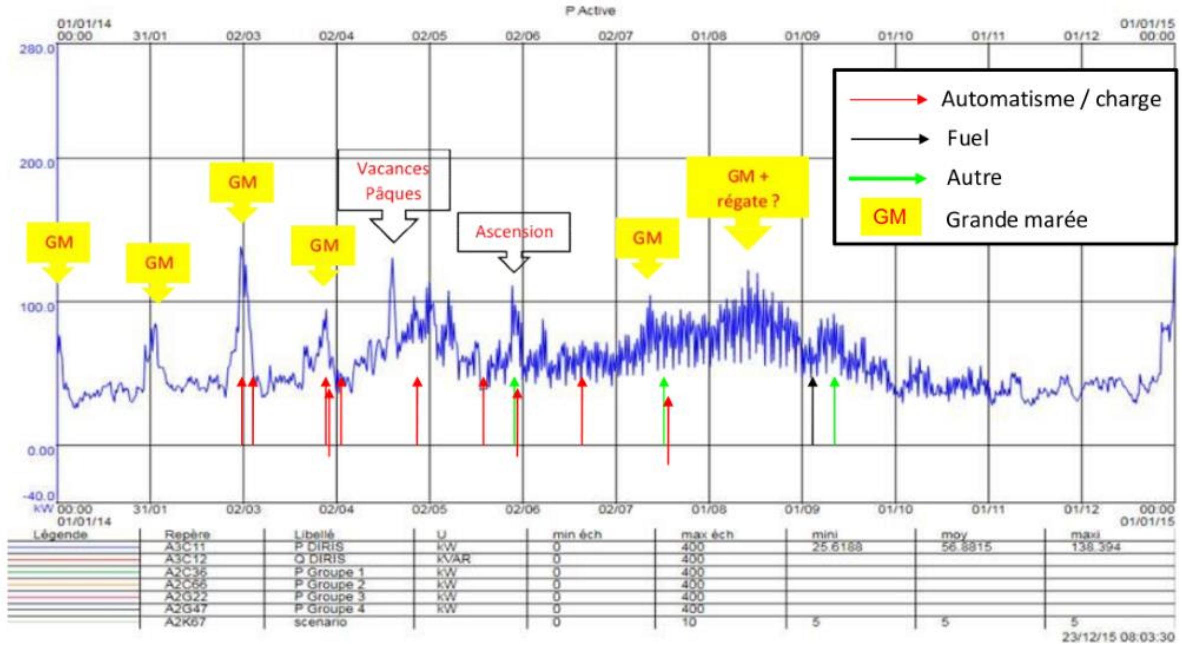


Figure 18 - Load curve 2014

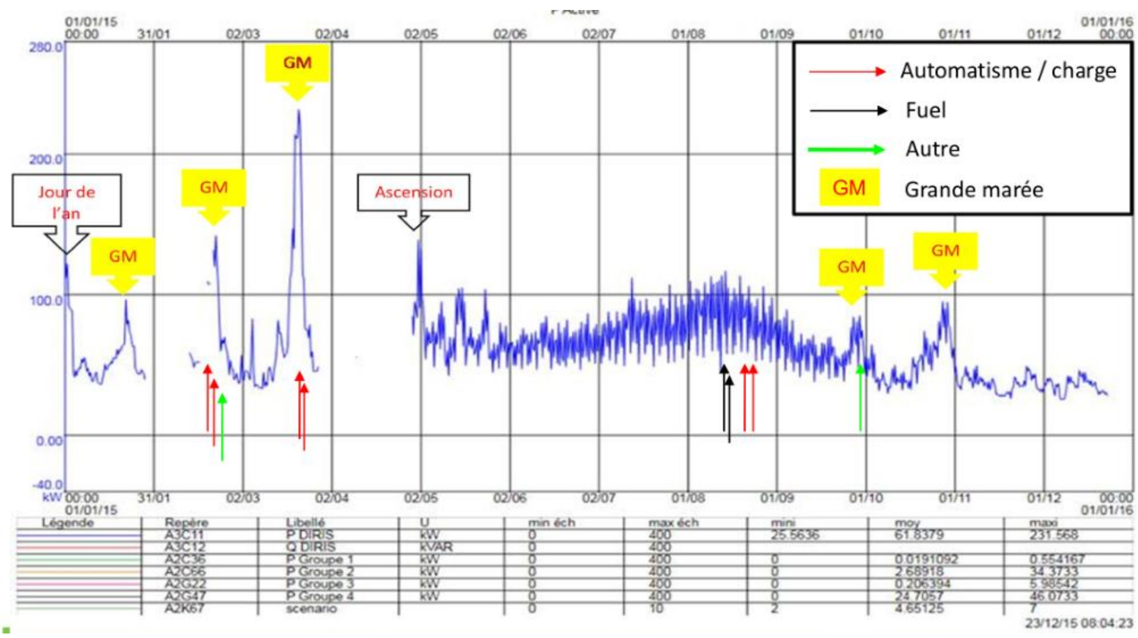


Figure 19 - Load curve 2015

As can be seen from these load curves, periods of high tide are periods during which the island of Grande Île experiences a huge peak in electricity consumption. This can be explained by the fact that during these periods the island has a great need for current.

It is also noticeable that during the summer period, from the beginning of April to the end of September, consumption fluctuates enormously, due to the fact that the daily needs of vacationers are very important during the day and decrease sharply at night, resulting in significant daily variations.

4.5.2.1 Electricity consumption on the island

There are no industrial or agricultural activities on the Chausey Islands, so all the energy consumed is attributed to the residential sector.

4.5.2.2 Consumption patterns

Consumption on the Chausey Islands is possible thanks to the generators on the east island, which provide a good supply of electricity for all the infrastructures.

However, in order to limit their use and reduce consumption on these highly polluting sources of electricity, the inhabitants have been equipped with low-energy light bulbs and water-saving devices. The installation of linky meters also makes it possible to monitor consumption and adapt electricity demand.

4.5.3 Evaluation of electricity production, transport and distribution means

4.5.3.1 Existing system

The following table presents the current power generation system on Grande Île.

	Fuel generator	***Solar power (in construction)***
Energy source	Fuel	Solar power
Produceur	EDF-SEI	EDF-SEI
Site	Grande île	Grande île
Date of commissioning	<=2011	From now to 2030
Connecting power(kW) / Capacity	60,7 kW	54 kW

Table 13 - Summary table of the Chausey Islands power supply system

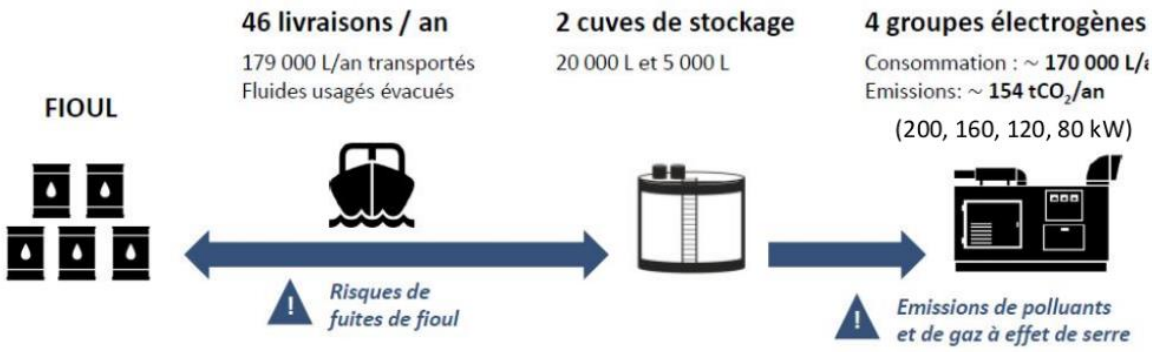


Figure 20 - Ecological impact of fuel oil use on Chausey

The pattern of electricity production on the Chausey Islands consists of production solely by generators (4). This type of system is extremely expensive and polluting and requires several equally expensive and polluting implementation stages (extraction of fuel oil, transport, storage). Moreover, the Chausey Islands cannot be equipped with onshore wind turbines as they are considered a protected site that cannot accommodate these installations.

4.5.3.2 Evaluation of the market for innovative technologies

As explained in Johan Daelman's preliminary study, characterizing the Marine Renewable Energy (MRE) resource is an expert work generally attributed to research institutes. Having had a brief introduction to the different types of information needed to characterize renewable resources, the objective is now simply to identify the institutes able to provide this kind of data for different renewable resources with a strong interest in MRE. Where some information is provided by the institutes or other documentation, it will be presented to illustrate the summary table.

In addition, the research carried out in the framework of this study has made it possible to access a lot of information related to this part via studies already carried out, websites, scientific articles, etc. The results gathered and deemed relevant will also be presented to give the reader a more precise idea of the renewable energy potential of this NZI.

The following summary table presents the institutes able to provide characterization data of the energy potential for each of the associated resources.

Type of resource	Institutes able to deliver resource characterization data
Tidal Energy from Tides	For France (and Europe to some extent), the tide directory of the French Navy's hydrographic and oceanographic service (SHOM) serves as a reference for a wide choice of ports.
Tidal Energy from Currents	The data portals of SHOM and the French Research Institute for Exploitation of the Sea (IFREMER) are to be queried as a priority. They have data on the intensity of surface and deep-sea currents.

Wave Energy from Waves	IFREMER's MARC model is a good tool for obtaining a directional spectrum of the swell. In addition, CEREMA offers a service for the installation and operation of a wave measuring station.
Wind energy	The Centre d'études et d'expertise sur les risques, l'environnement, la mobilité et l'aménagement (CEREMA) offers a service for assessing the deposits, potential and impacts of marine renewable energies. The meteoblue platform shares local meteorological data for the whole world with a resolution of 30 km. Wind roses are offered. For greater accuracy, they offer high-resolution simulations with data for every hour.

Table 14 - Presentation of the institutes providing renewable resource data for Chausey

4.5.4 Evaluation of energy transition policies

4.5.4.1 Identification of local actors

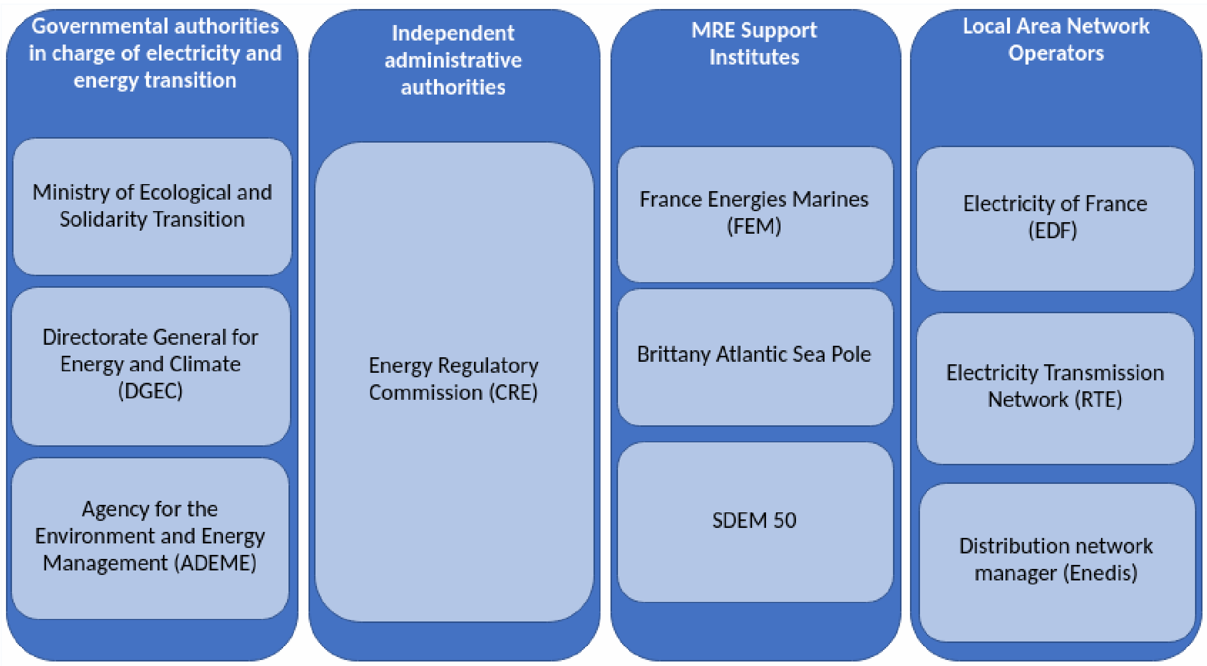


Figure 21 - Local actors of the island of Chausey

4.5.4.2 Identification of existing programs and current energy transition policies

Due to the current climate emergency, Grande Île, located in the Chausey archipelago, wishes to implement measures and facilities to reduce its carbon dioxide emissions and to achieve a clean energy dependency.

In collaboration with the Syndicat des Energies de la Manche, the island wishes to reach its 2030 goal by developing its exploitable solar farm and hydrogen generator to compensate for days with little sunshine. This transition will make the use of the 4 diesel generators obsolete in the future.

This project is supported by several institutional actors, ranging from the SDEM50 to the Directorate General for Energy and Climate (DGEC).

For the moment, the time has come to raise awareness of the energy transition among its inhabitants. This involves information meetings, forums and the distribution of low-energy light bulbs.

This "smooth" start to the transition also involves renovating and improving the island's buildings to reduce energy consumption

.

4.5.4.3 Assessment of the relevance of ongoing programs and projects

The project to become 100% clean in terms of energy production has been launched since at least 2018 and proposes to make the island eco-productive to the order of 50% by 2023.

To date and to our knowledge, there is no quantitative data on the green energy production on the island.

4.5.5 Contacts

Contacts for electricity supply and power grid management	* Electricity generator: EDF (Electricité De France) Website: https://www.edf.fr/contacts/institutionnels Local number: 09 69 32 15 15
Local authorities	* Granville town hall Website: https://www.ville-granville.fr Phone: 02 33 91 30 00 Mail: mairie@ville-granville.fr Mayor: Gilles Ménard

Contacts able to support the implementation innovative energy solutions by companies	* SDEM 50 (smart energy network project leader) Website: https://www.sdem50.fr Mail: sdem@sdem50.fr Phone: 02 33 77 77 18 95
Research institutes and other contacts able to transmit elements to characterize renewable resources	*SHOM : https://data.shom.fr * Meteoblue : https://www.meteoblue.com/fr/meteo/historyclimate/climatemodelled/ouessant_france_6618260 *The National Wind Speed (NOABL) : http://www.renew-reuse-recycle.com/noabl.pl?n=503 * Global Solar Atlas: https://globalsolaratlas.info/map * Copernicus Climate Data Store: https://cds.climate.copernicus.eu/cdsapp#!/home

Table 15 - Contacts for Chausey

4.6 Sark Island - Île de Sercq, îles Anglo-Normandes [England]

4.6.1 Island's presentation

The island of Sark, the last seigniory in Europe, is located off the coasts of Guernsey (10 kilometres) and Jersey (20 kilometres), north-west of Jersey and 40 kilometres from the French coast. The island has a population of 600 inhabitants and a population density of 100 inhabitants/km², with a notable increase in the summer period. The island has its own parliament and is under the dome of the United Kingdom.

Not connected by an underwater cable to the continent, it has four diesel generators producing a total power of 2MW. According to our resources, the island does not have any renewable solutions such as wind or photovoltaic power for the overall production of electricity. Having suffered a power distribution crisis in recent years, it wishes to turn to renewable energy production systems in order to reduce its production costs.

4.6.2 Evaluation of electricity consumption

4.6.2.1 Electricity consumption on the island

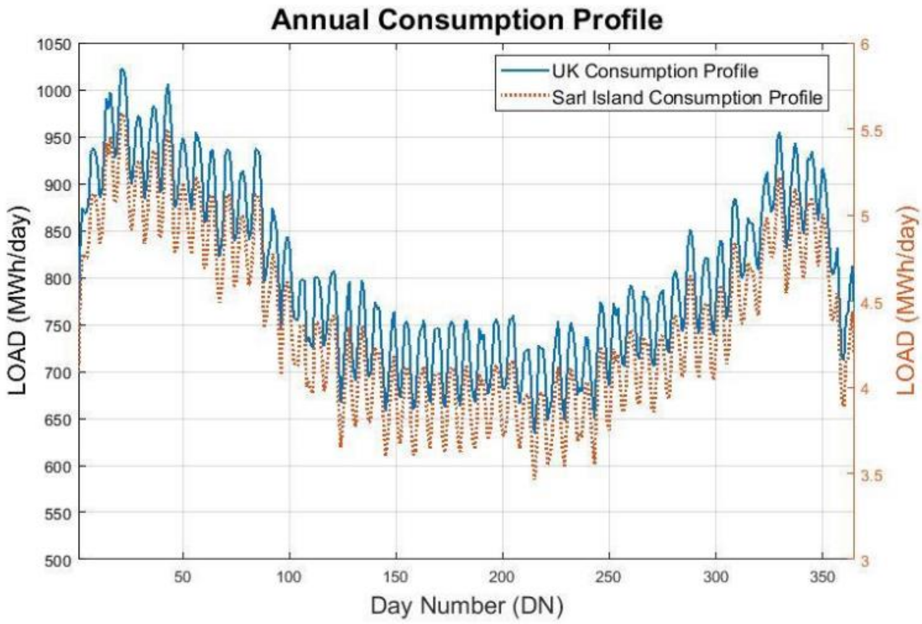


Figure 22 - Annual consumption UK/Sark 2019

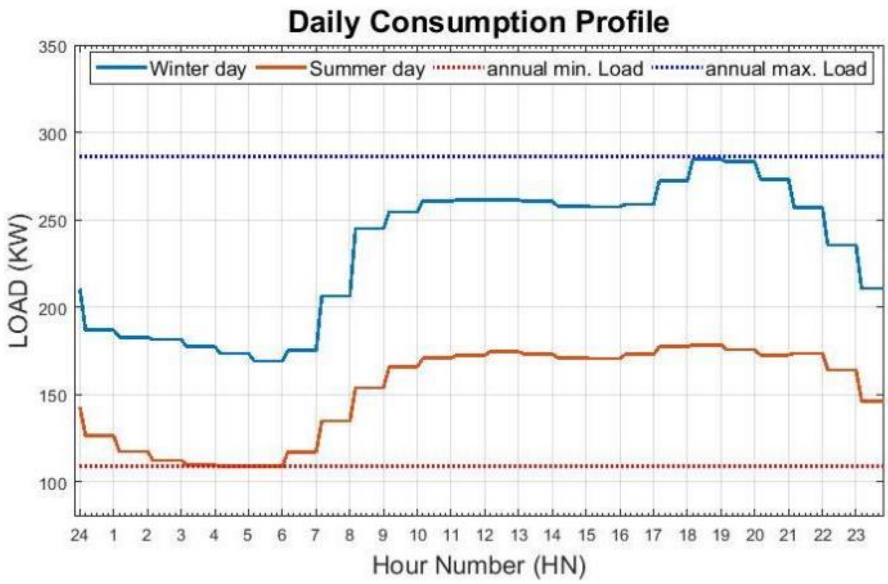


Figure 23 - Daily consumption SARK

We can see on these two graphs that the consumption on Sark Island is as follows:

- Over a year, electricity consumption is higher (by a factor of about 30%) in winter (from the end of October to March) than in summer. This is due to the need for electric heating and the use of a stronger current during this period. Consumption is like that of the country but is lower overall.
- On average over a day we have a classic consumption profile with an off-peak system between 1am and 7am and a higher consumption during the rest of the day. As explained above, the winter consumption profile is much higher in value than in summer.

4.6.2.2 Consumption by consumer category and geographic area

As the island is sparsely populated and motor vehicles are prohibited, there are no industrial or agricultural activities on the island. The island's economy is based on tourism.

Thus, the entire electricity consumption can be distributed among all the inhabitants, thus constituting a total residential pole.

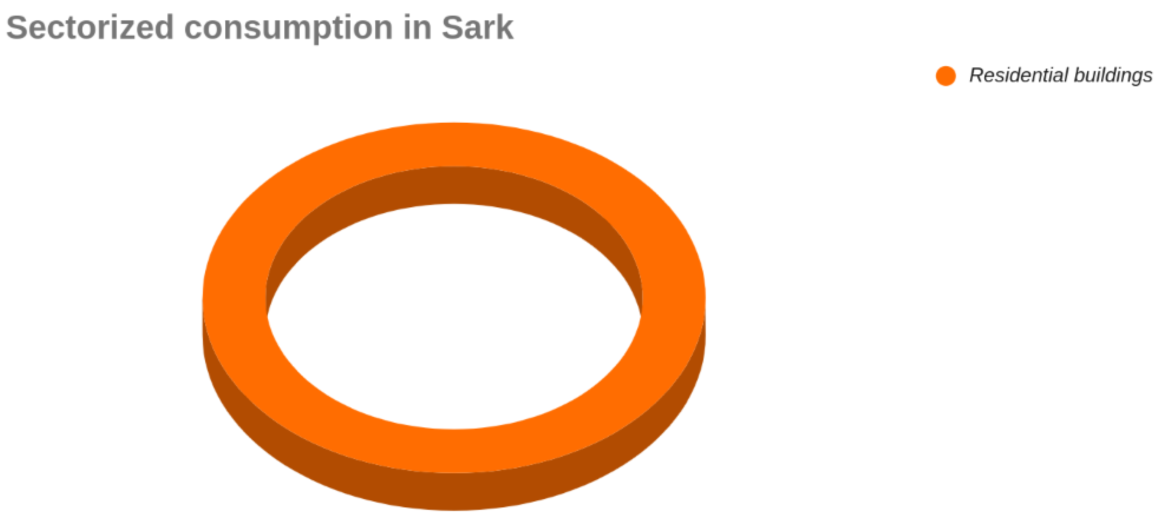


Figure 24 - Consumption by sector in Sark

4.6.2.3 Consumption patterns

Here we will present the consumption pattern of Sark Island. There is no programme on the island that provides direct assistance to the population to consume less and reduce their emissions, in the sense that we have found no evidence of a programme to provide LED lighting to the inhabitants or assistance in the renovation of installations.

The banning of motorized vehicles on the island helps to reduce the overall consumption impact, however, all the island's electricity is produced thanks to these 4 fuel oil generators.

The distribution of this produced energy is possible thanks to electrical cables connecting the power plant to the terminals and electrical boxes.

4.6.3 Evaluation of electricity production, transport and distribution means

4.6.3.1 Existing system

The following table shows the current electricity generation system on Sark Island.

	4 fuel generators		
	720 KVA Perkins engine/Stamford alternator 3012/CV12 TAG3A set x1	***600 KVA Perkins engine/Stamford alternator 30102/CV12 TAG1A set x1***	***375 KVA Cummins engine/Stamford alternator KTA19G2 sets x2***
Energy source	Fuel	Fuel	Fuel
Producer	Sark electricity	Sark electricity	Sark electricity
Site	Sark	Sark	Sark
Date of commissioning	Between 1990 and 2008		
Connecting power (kW) / Capacity	183		

+ 2x600 KVA transformers

Table 16 - Current electricity generation system on Sark Island

The existing system of electricity production on Sark Island is entirely provided by the production of Sark electricity using 4 fuel oil generators. This production provides 230V at 50Hz to all households on the island.

4.6.3.2 Evaluation of the market for innovative technologies

As explained in Johan Daelman's preliminary study, characterizing the Marine Renewable Energy (MRE) resource is an expert work generally attributed to research institutes. Having had a brief introduction to the different types of information needed to characterize renewable resources, the objective is now simply to identify the institutes able to provide this kind of data for different renewable resources with a strong interest in MRE. Where some information is provided by the institutes or other documentation, it will be presented to illustrate the summary table.

In addition, the research carried out in the framework of this study has made it possible to access a lot of information related to this part via studies already carried out, websites, scientific articles, etc. The results gathered and deemed relevant will also be presented to give the reader a more precise idea of the renewable energy potential of this NZI.

The following summary table presents the institutes able to provide characterization data of the energy potential for each of the associated resources.

Type of resource	Institutes able to deliver resource characterization data
Tidal Energy from Tides	For France (and Europe to some extent), the tide directory of the French Navy's hydrographic and oceanographic service (SHOM) serves as a reference for a wide choice of ports.
Tidal Energy from Currents	The data portals of SHOM and the French Research Institute for Exploitation of the Sea (IFREMER) are to be queried as a priority. They have data on the intensity of surface and deep-sea currents.
Wave Energy from Waves	IFREMER's MARC model is a good tool for obtaining a directional spectrum of the swell. In addition, CEREMA offers a service for the installation and operation of a wave measuring station.
Wind energy	The Centre d'études et d'expertise sur les risques, l'environnement, la mobilité et l'aménagement (CEREMA) offers a service for assessing the deposits, potential and impacts of marine renewable energies. The meteoblue platform shares local meteorological data for the whole world with a resolution of 30 km. Wind roses are offered. For greater accuracy, they offer high-resolution simulations with data for every hour.

Table 17 - Presentation of the institutes providing renewable resource data for Sark island

4.6.4 Evaluation of energy transition policies

4.6.4.1 Identification of local actors

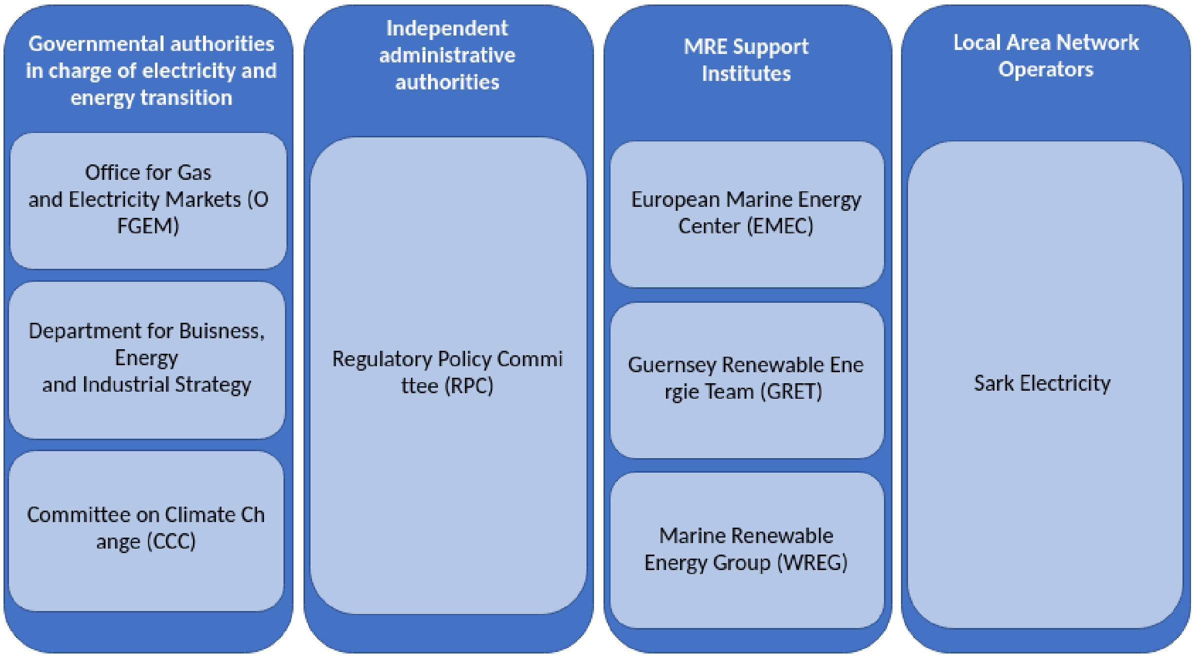


Figure 25 - Local actors of Sark

4.6.4.2 Identification of existing programs and current energy transition policies

The island of Sark, located opposite Guernsey, is aiming to become energy independent and renewable in the very near future, due to the major costs of importing and using fuel oil for its energy production, making Sark's electricity one of the most expensive in the UK. In addition to this, the company is keen to use a green energy source to reduce its carbon footprint.

In order to achieve this type of objective, Guernsey and Sark set up GRET to develop and implement policies and strategies for the development and implementation of eco-responsible energy production solutions.

This body deals with and commissions feasibility studies of various possible scenarios to enable the implementation of this type of green production on the islands in question, such as Sark. All types of solutions are being studied, from photovoltaic to tidal power and wave energy.

The island therefore has all the tools it needs to implement a well thought out and precise programme to provide it with an eco-responsible energy production solution.

4.6.4.3 Assessment of the relevance of ongoing programs and projects

The work upstream of the realization of an eco-responsible project has been almost completely completed. It is mainly accessible online, and the organization is waiting for a concrete and defined project to allow the launch of the major transition of the island of Sark.

4.6.5 Contacts

Contacts for electricity supply and power grid management	* Electricity generator: **Sark electricity** Website: http://www.sarkelectricity.com Local number: +44 1481 832053
Competent local authorities	***Sark Tourism Office The Avenue** Email : office@sark.co.uk Tel : +44 (0) 1481 832345
Contacts able to support the implementation innovative energy solutions by companies	* **Guernesey Renewable Energy Team** Web site: http://www.guernseyrenewableenergy.com Téléphone: 01481 234567 Mail: enquiries@guernseyrenewableenergy.com
Research institutes and other contacts able to transmit elements to characterize renewable resources	* Meteoblue : https://www.meteoblue.com/fr/meteo/historyclimate/climatemodelled/ouessant_france_6618260 *The National Wind Speed (NOABL) : http://www.renew-reuse-recycle.com/noabl.pl?n=503 * Global Solar Atlas: https://globalsolaratlas.info/map * Copernicus Climate Data Store: https://cds.climate.copernicus.eu/cdsapp#!/home

Table 18 - Contacts for Sark

4.7 Alderney island - Île de Aurigny, îles Anglo-Normandes [England]

4.7.1 Island's presentation

The island of Alderney is located 15 kilometres off the Normandy Point in the English Channel. It has a population of 2020 inhabitants and a relatively high density of 259 inhabitants/km².

The island is currently electrically isolated from the mainland, with all its electricity consumption being generated by 8.4 MW diesel generators. The FAB project for a submarine cable across the English Channel from Normandy to England, due to start in 2021, is due to pass through the island but is highly controversial among the local population.

The island has a commission for renewable energy and is geared towards power generation from currents although no solution is yet in place.

4.7.2 Evaluation of electricity consumption

4.7.2.1 Electricity consumption on the island

After multiple attempts to contact the island's local authorities, we did not receive any response. We are not able to present consumption data for this island. Here is a list of the contacted organisations:

State of Alderney	Mail : info@alderney.gov.gg
Alderney Electricity Ltd	Mail : manager@alderney-elec.com

4.7.3 Evaluation of electricity production, transport and distribution means

4.7.3.1 Existing system

The system providing electricity on Alderney is composed of 8 diesel generators with a capacity of 8,4MW. These generators are modern as the State of Alderney financed a plant renovation plan in 2017.

4.7.3.2 Evaluation of the market for innovative technologies

The potential for MRE in Alderney's waters is immense as evidenced by the map of the island's surface currents below and the map of deep currents below (source: SHOM).

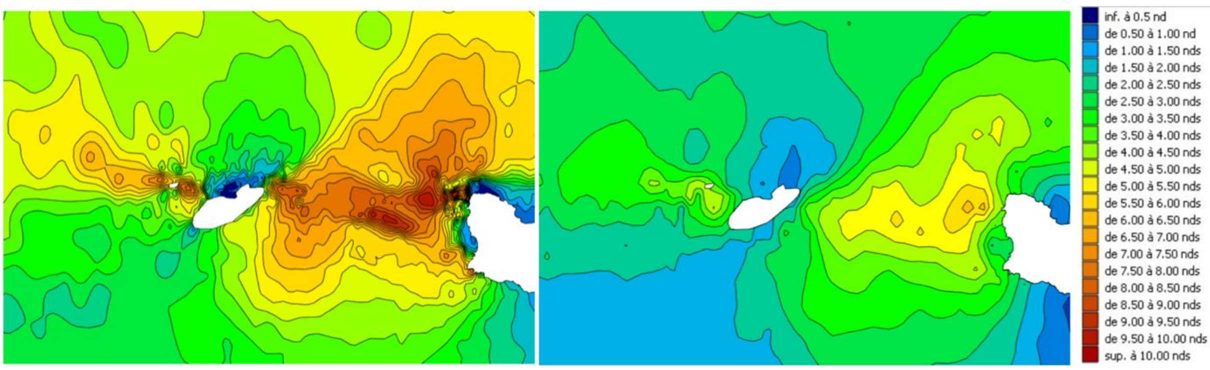


Figure 26 – Map of surface currents and deep-sea currents in Alderney waters

The Race is known for its high power currents ideal for MRE.

As explained in Johan Daelman's preliminary study, characterizing the Marine Renewable Energy (MRE) resource is an expert work generally attributed to research institutes. Having had a brief introduction to the different types of information needed to characterize renewable resources, the objective is now simply to identify the institutes able to provide this kind of data for different renewable resources with a strong interest in MRE. Where some information is provided by the institutes or other documentation, it will be presented to illustrate the summary table.

In addition, the research carried out in the framework of this study has made it possible to access a lot of information related to this part via studies already carried out, websites, scientific articles, etc. The results gathered and deemed relevant will also be presented to give the reader a more precise idea of the renewable energy potential of this NZI.

The following summary table presents the institutes able to provide characterization data of the energy potential for each of the associated resources.

Type of resource	Institutes able to deliver resource characterization data
Tidal Energy from Tides	For France (and Europe to some extent), the tide directory of the French Navy's hydrographic and oceanographic service (SHOM) serves as a reference for a wide choice of ports.
Tidal Energy from Currents	The data portals of SHOM and the French Research Institute for Exploitation of the Sea (IFREMER) are to be queried as a priority. They have data on the intensity of surface and deep-sea currents.
Wave Energy from Waves	IFREMER's MARC model is a good tool for obtaining a directional spectrum of the swell. In addition, CEREMA offers a service for the installation and operation of a wave measuring station.
Wind energy	The Centre d'études et d'expertise sur les risques, l'environnement, la mobilité et l'aménagement (CEREMA) offers a service for assessing the deposits, potential and impacts of marine renewable energies. The meteoblue platform shares local meteorological data for the whole world with a resolution of 30 km. Wind roses are offered. For greater accuracy, they offer high-resolution simulations with data for every hour.

Table 19 - Presentation of the institutes providing renewable resource data for Alderney island

4.7.4 Evaluation of energy transition policies

4.7.4.1 Identification of local actors

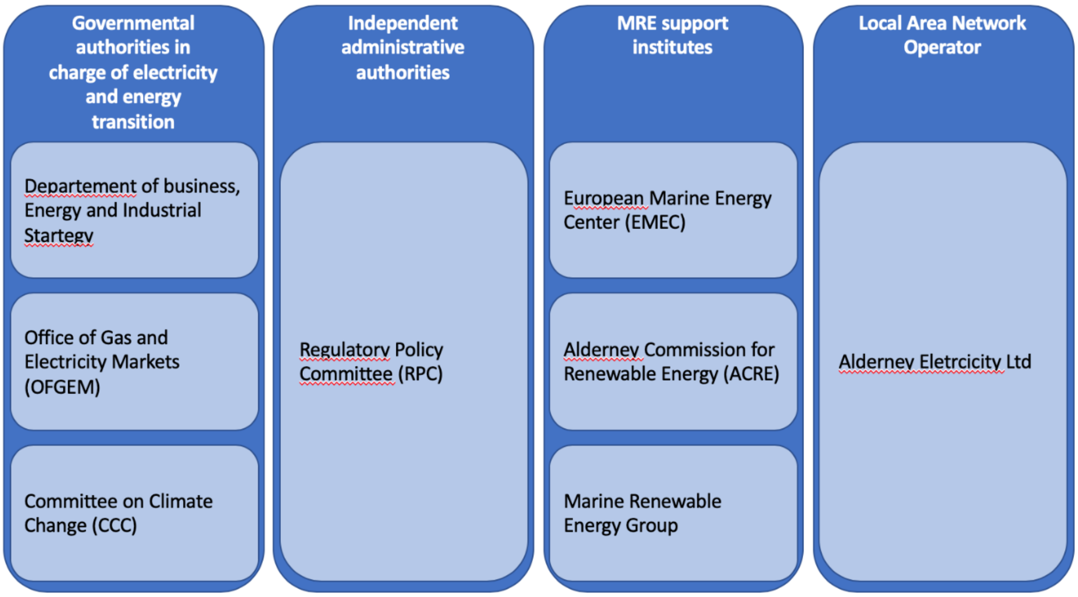


Figure 27 - Local actors of Alderney

4.7.4.2 Identification of existing programmes and current energy transition policies

The FAB project is to build an electrical interconnector underwater and underground between France and Great Britain via the island of Alderney.

This project, which allows a maximum transmission of 1400MW (1MW is 1000kW), will help to meet the need for increasing the capacity of energy trade between the two countries and thus contribute to the energy transition in Europe. The project is also designed to provide a route to market for marine renewable energy planned to be constructed in the seas around Alderney.
The project is scheduled to commence construction from 2021. This project is being jointly developed by RTE and FAB Link Limited.

Figure 28 - Overview of the FAB Project

A joint venture between Open Hydro and Alderney Renewable Energy (ARE) is also tasked with the project of building a marine turbine farm in Alderney waters. This farm will be composed of 150 turbines of 2 MW each, producing enough electricity for over 150,000 homes.

Open Hydro and ARE have been working in close collaboration for years. In 2008, ARE negotiated a deal with Alderney authorities granting it access to 50% of its territorial waters for renewable energy generation for 65 years. Open Hydro will provide the marine turbines built in Cherbourg.

4.7.4.3 Assessment of the relevance of ongoing programmes and projects

The FAB project is an immense opportunity for the ICE project. It is proof of Alderney's willingness to develop renewable solution for electricity generation. Although the deal between ARE and Alderney condemns 50% of its waters, a large portion stays open to business for other companies.

4.7.5 Contacts

Contacts for electricity supply and power grid management	* Electricity producer and distributor: Alderney Electricity Ltd Web site: https://alderney-elec.com Numero: 01481 822715 Mail: manager@alderney-elec.com
Local authorities	* State of Alderney Phone: +44(0)1481 822811 Mail : info@alderney.gov.gg Web site: http://www.alderney.gov.gg
Contacts able to support the implementation innovative energy solutions by companies	* Alderney commision for renewable energy Mail: https://www.acre.gov.gg Phone: +44(0)1481 822357 Mail : info@acre.gg

Table 20 - Contacts for Alderney

4.8 Isles of Scilly - Île de Scilly [England]

4.8.1 Island's presentation

The Isles of Scilly are a very isolated archipelago, located 45 kilometres off the Lizard Peninsula in Cornwall. 2280 people live on the 5 main islands for a density of 149 inhabitants/km².

A single submarine cable connects the islands to England but the 7 diesel generators, which supplied the islands until 1989, have been kept as 500kVA backup generators. The Smart Islands project led by the islands aims to achieve electricity production from 40% renewable energy by 2025.

4.8.2 Evaluation of electricity consumption

4.8.2.1 Electricity consumption on the island

Trends in electricity consumption on the island have been communicated to us by the Council of the Isles of Scilly. However, no figures have been transmitted. The following data and curves are taken from a 2016 report produced by Hitachi Europe Ltd for the Isles of Scilly Council detailing the Smart Islands project.

Firstly, the seasonal evolution of electricity consumption shows a peak in annual consumption in April. The maximum consumption can reach 4.5MW but this is only the case for a few hours per year. The average demand is about 2MW.

The next curve shows the evolution of consumption for one day.

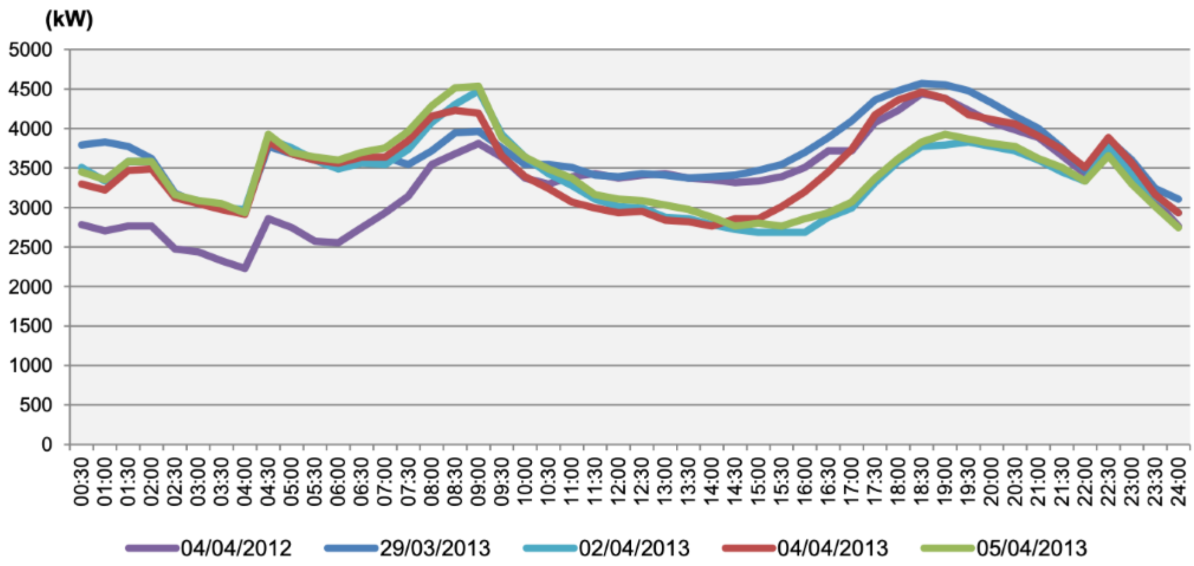


Figure 29 - Electricity consumption during one day for the isles of Scilly

In its report, Hitachi Europe Ltd. calculated the average daily consumption for each month from June 2011 to May 2014. They showed a monthly average consumption of 1588MWh with consumption peaks on April days. It has been estimated that the total consumption per year is 18500MWh.

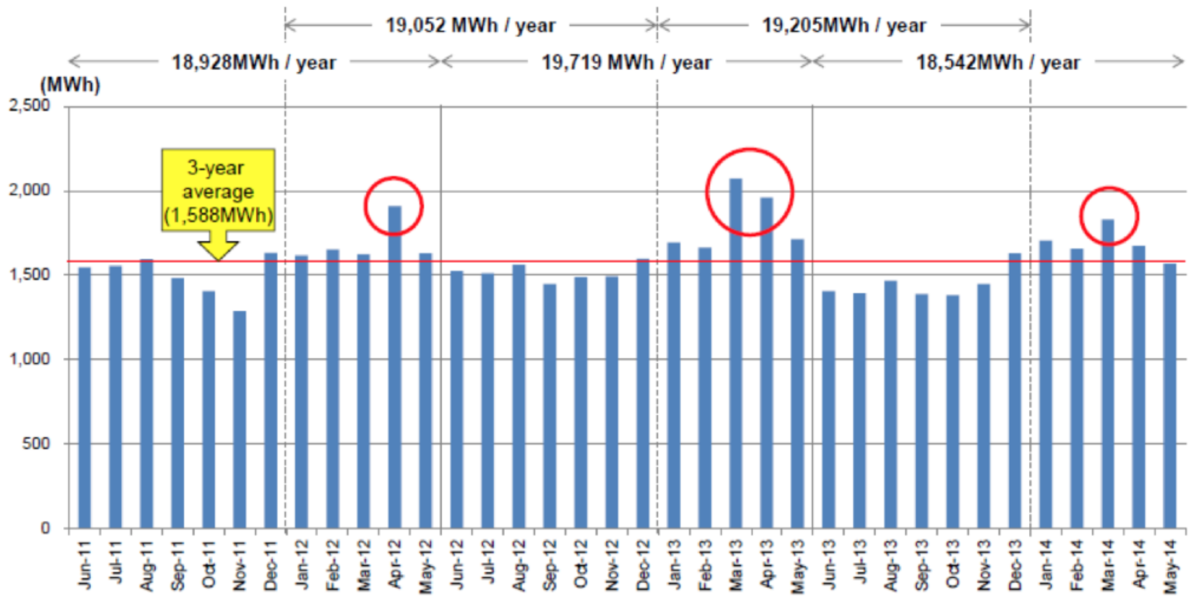


Figure 30 - Average monthly consumption for the isles of Scilly

4.8.2.2 Consumption patterns

The population of the Isles of Scilly is seasonal due to the importance of tourism on the island. The population can therefore be 6000 people in summer, against 2200 in winter. Most of the resident population lives on the main island of St Mary.

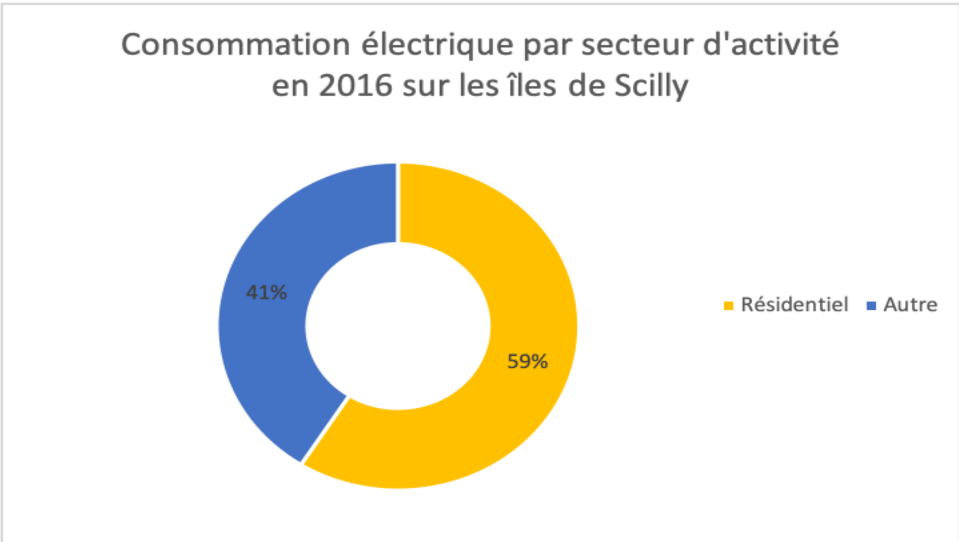


Figure 31 - Electricity demand for the isles of Scilly

According to the island's distribution system operator, Western Power Distribution, there are 1678 customers on the system. Of these, 989 are residential, leaving 689 industrial, commercial and public buildings. The share of industry is small (exact figures not given) and concentrated around Porthmellon on the main island.

4.8.3 Evaluation of electricity production, transport and distribution means

4.8.3.1 Existing system

The Isles of Scilly are supplied with electricity via a 33kV submarine cable running from Cornwall to the main substation at St Mary's. The cable runs from Cornwall to the main substation at St Mary's. The cable is a 33kV submarine cable. From there, electricity is distributed to the four 11 kV cables which then supply the islands.

The submarine cable dates from 1989 and is therefore 31 years old this year. It is a single cable and has been reliable in the past. It should be noted that the grid in Cornwall is particularly busy and no electricity can be sent from the islands to England.

The old power generation station which supplied the islands before 1989 is still used as a back-up generator in the event of a failure of the submarine cable. The station consists of 7 diesel generators in good working order despite their age (they date from the 1960s, 70s and 80s). We know that they do not operate more than 200 hours per year, but they are not obliged to comply with environmental standards on particle emissions. The generators are used between 25 and 30 times a year during the peak half hours (Triads). It should be noted that in case of prolonged cable failure, further maintenance of the station will be required and environmental standards will have to be respected. This station is owned by Western Power Distribution and any modernization is their responsibility.

4.8.3.2 Evaluation of the market for innovative technologies

Here is a map, from the SHOM, of the maximum speeds of the surface currents around the Isles of Scilly for an average spring tide.

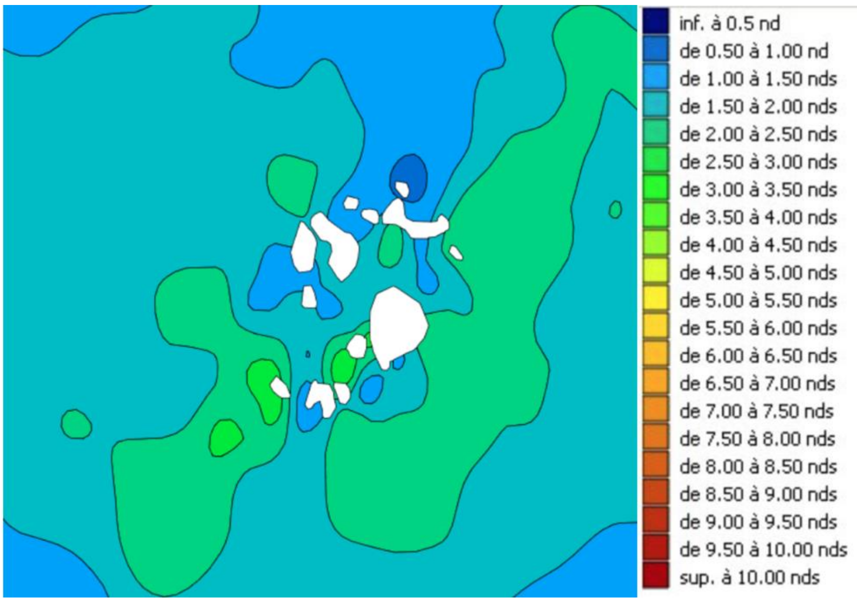


Figure 32 - Map of the currents in Scilly waters

Below is a map of the currents in the South West of England.

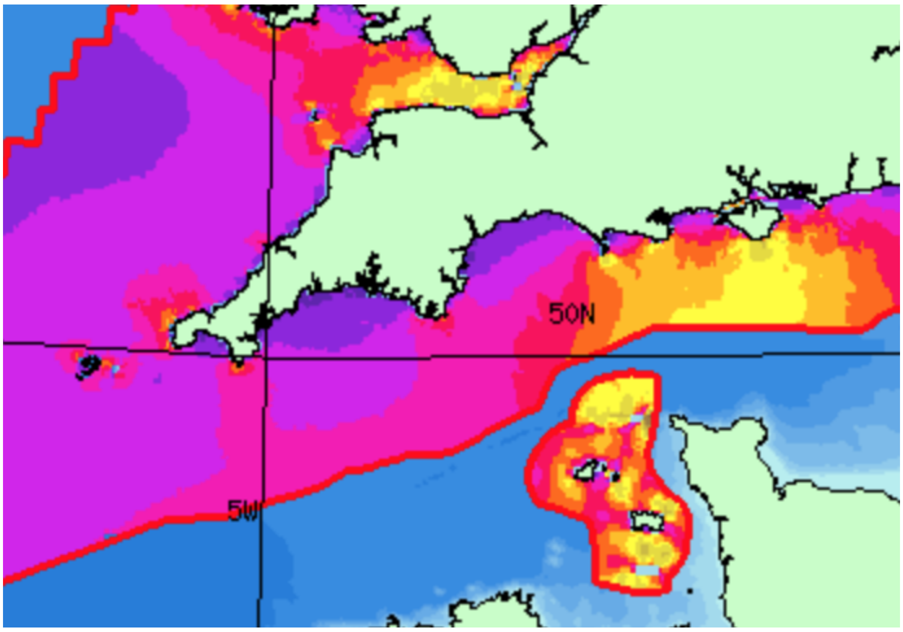


Figure 33 - Map of the currents in the South-West of England

We can see that the Isles of Scilly are not surrounded by strong currents as is the case in the English Channel for example. However, the technology could work in some places.

The Hitachi Europe Ltd report identified some areas of interest for the development of tidal turbines from a currents point of view but which in practice prove to be too shallow for some.

However, according to the report, the islands have a large wave resource. A development of wave solutions would therefore be preferable for these islands.

As explained in Johan Daelman's preliminary study, characterizing the Marine Renewable Energy (MRE) resource is an expert work generally attributed to research institutes. Having had a brief introduction to the different types of information needed to characterize renewable resources, the objective is now simply to identify the institutes able to provide this kind of data for different renewable resources with a strong interest in MRE. Where some information is provided by the institutes or other documentation, it will be presented to illustrate the summary table.

In addition, the research carried out in the framework of this study has made it possible to access a lot of information related to this part via studies already carried out, websites, scientific articles, etc. The results gathered and deemed relevant will also be presented to give the reader a more precise idea of the renewable energy potential of this NZI.

The following summary table presents the institutes able to provide characterization data of the energy potential for each of the associated resources.

Type of resource	Institutes able to deliver resource characterization data
Tidal Energy from Tides	For France (and Europe to some extent), the tide directory of the French Navy's hydrographic and oceanographic service (SHOM) serves as a reference for a wide choice of ports.
Tidal Energy from Currents	The data portals of SHOM and the French Research Institute for Exploitation of the Sea (IFREMER) are to be queried as a priority. They have data on the intensity of surface and deep-sea currents.
Wave Energy from Waves	IFREMER's MARC model is a good tool for obtaining a directional spectrum of the swell. In addition, CEREMA offers a service for the installation and operation of a wave measuring station.
Wind energy	The Centre d'études et d'expertise sur les risques, l'environnement, la mobilité et l'aménagement (CEREMA) offers a service for assessing the deposits, potential and impacts of marine renewable energies. The meteoblue platform shares local meteorological data for the whole world with a resolution of 30 km. Wind roses are offered. For greater accuracy, they offer high-resolution simulations with data for every hour.

Table 21 - Presentation of the institutes providing renewable resource data for Scilly island

4.8.4 Evaluation of energy transition policies

4.8.4.1 Identification of local actors

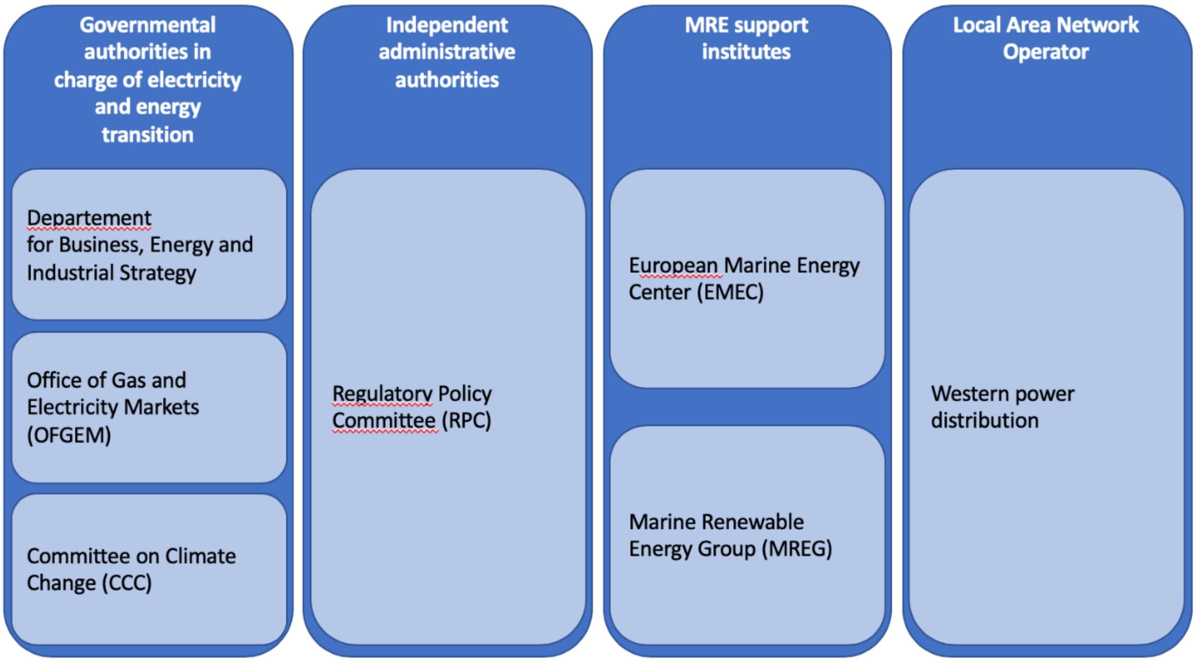


Figure 34 - Local actors of the isles of Scilly

4.8.4.2 Identification of existing programmes and current energy transition policies

The Smart Islands program is intended to sustainably and affordably tackle some of the Isles of Scilly’s main infrastructure and utilities issues, whilst providing a model for how other communities can profit from a rapid transition from being carbon intensive to having a low carbon footprint. The program has the following goals:

1. 20% reduction in electricity bills by 2020 (40% by 2025)
2. 40% of the isles’ energy demand met through renewable generation by 2025
3. 40% of vehicles being low carbon or electric by 2025
4. Internships, cultural exchange and STEM* skill delivery for young people
5. Full program of energy efficiency measures delivered by 2020.

The current challenges are considerable. Providing affordable and reliable electricity, drinking water, sewage treatment and waste disposal for Scilly’s remote island population is expensive and presents considerable practical challenges. This must all be achieved within the beautiful but sensitive environmental and heritage context of the islands.

There is an exciting opportunity on Scilly to take a fundamentally different approach to waste, water and energy. The ambitious goals of the program can be achieved by the introduction of a Smart Grid, generating energy from waste, sewerage and a mix of renewable energy sources; unlocking value and savings for Scilly’s residents and businesses through a locally owned Community Energy Services Company.

The program is being delivered through a partnership made up of the following organisations: The Duchy of Cornwall, Tresco Estate, The Council of the Isles of Scilly, Hitachi Europe Ltd. and the Islands' Partnership. More organisations are expected to join as projects are developed.

As part of this project, 10% of the homes on St Mary will be equipped with solar panels. Some have been installed on the recycling plant, the fire station and the desalinization plant and a small solar garden as built near the airport.
Furthermore, batteries have been installed in certain homes to allow people to use the solar energy produced during the day.

4.8.4.3 Assessment of the relevance of ongoing programmes and projects

The programme was initiated at a local scale which can offer an efficient collaboration. The goals of the program are completely adequate with the ICE project. Also, the program covers a large sector of expertise which can be interesting for the companies working with the ICE project.

4.8.5 Contacts

Contacts for electricity supply and power grid management	*Electricity distributor: Western Power Distribution Phone: 0800 096 3080 Mail: wpdinnovation@westernpower.co.uk Web site: https://www.westernpower.co.uk
Local authorities	* Council of the isles of Scilly Phone : 0300 1234 105 Mail: enquiries@scilly.gov.uk Web site: https://www.scilly.gov.uk

Table 22 - Contacts for the isles of Scilly

4.9 Lundy Island - Île de Lundy [England]

4.9.1 Island's presentation

Lundy Island is in the Celtic Sea 20 km off the Devon coast near the Bristol Channel. This British island has a population of 28 inhabitants and a population density of 6.3 inhabitants/km² but it welcomes many visitors during the navigation season. It has a campsite and 23 cottages and is open all year round, but the main season is from May to September.

Not connected to the mainland by a submarine cable, Lundy Island is completely electrically isolated. Its energy production is based on its own oil-fired electricity generator, which is normally switched off at midnight until dawn due to the high price of fuel. In addition, the island also uses wind power. In addition, there is a willingness on the part of the island to move away from dependence on fossil fuels and towards other sources of renewable energy. The island has a wide range of renewable resources including photovoltaics, marine energy and wind power, which according to The National Trust has promising potential.

4.9.2 Evaluation of electricity consumption

4.9.2.1 Electricity consumption on the island

The data below is taken from the energy assessment report carried out by Aardvark EM Lt. This energy assessment of Lundy Island took place throughout 2016, with results presented in February 2017.

As Lundy Island does not have electricity meters, no data is therefore available to show changes in instantaneous electricity consumption at different scales, whether annual, seasonal or daily. Nevertheless, electricity demand values were estimated by the study using various methods including the EPC (Energy Performance Certificate) method and various preliminary studies. The results were cross-checked with a previous study carried out in 1999. The study indicates that the evaluation approach used can be considered relatively reliable as it was able to be compared with historical analysis and recent energy supply data. As such, it provides sufficiently accurate forecasts of energy demand on Lundy Island. It is also important to note that the island's electricity consumption accounts for 96% of the total energy consumption of the island, the rest being supplied by gas cylinders.

The study therefore presents a whole approach to arrive at data on average electricity consumption over one year according to 3 types of buildings:

- Rented buildings with an occupancy rate of 80%, representing 23 properties,
- Staff buildings with a 100% occupancy rate representing 20 properties,
- The other buildings on the island dedicated to the various operations that meet the needs of staff and visitors, representing 14 properties (church, laundry, boathouse, telecommunications room, lambing shed, local shop, etc.).

The average electricity consumption data is presented in the following table:

Building type	Average electrical consumption (MWh)
Rental Buildings	798.78
Staff Buildings	439.71
Other buildings	198.47
Total over one year	**1436.96**

Table 23 - **Average and annual electricity consumption of different types of dwellings on Lundy Island**

The following figure shows the distribution of average electricity consumption over one year according to the 3 types of buildings on the island:

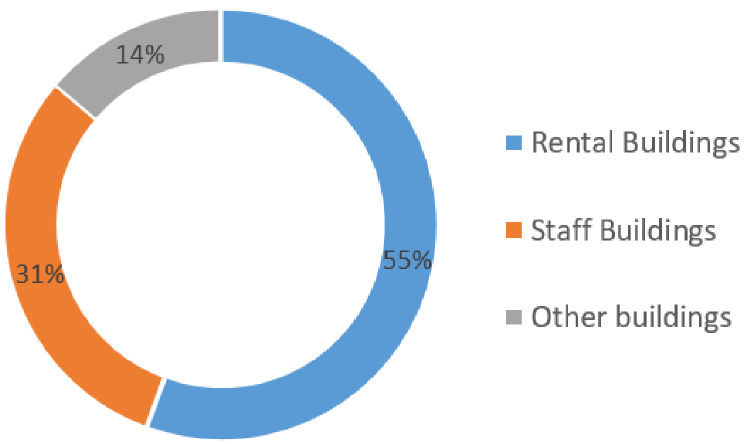


Figure 35 - Distribution of average electricity consumption over one year according to the 3 types of buildings on Lundy Island

As the study was able to present in its report, these results can also be summarised in a table summarising the estimated total demand in terms of average power taking into account the occupancy rate:

Building type	Average electrical demand (kW)
Rental Buildings	73
Staff Buildings	50
Other buildings	23
Total over one year	**146**

Table 24 - Estimated Average Electricity Demand by Building Type on Lundy Island

These results were compared with an alternative method of estimating electrical demand using the volume of fuel used on the island. Indeed, as the study explains, considering that the island consumes 127,750 litres of diesel per year (data provided by the island) and using a calorific value greater than 46.00 MJ/kg, this is equivalent to 1,387,507 kWh of available energy per year. Furthermore, since the engines run on average 18 hours per day and have an assumed electrical efficiency of 40%, this equates to an electrical generating capacity of 84 kW. The information used in this calculation is presented in more detail in the report provided by Aardvark EM Lt. Nevertheless, although estimates of energy demand on the island based on the EPC assessment indicate slightly higher results, it should be noted that the EPC method applies several standardised values. In addition, the estimate of energy consumption in buildings is based on size and number of rooms and not on occupancy, which can overestimate energy demand.

Based on these two methods, the study pointed out that it did not allow for variations in instantaneous energy demands. Meters should therefore be installed in the future for greater accuracy, but the study nevertheless recommends a production capacity of 175 kW. This would allow for future growth in tourism on the island as well as peaks in consumption.

4.9.2.2 Consumption patterns

The following section aims to present the consumption pattern of Lundy Island with a particular focus on identifying the least energy efficient activities. Indeed, some measures have been identified to improve the energy efficiency of the island such as:

- The installation of electricity meters for all service buildings, staff accommodation and holiday rentals with accompanying documentation to encourage behavioural changes to reduce energy consumption,
- Completion of the installation of LED lighting in all buildings (lighting system upgrade programme underway in 2016),
- The introduction of a sensor-controlled lighting system in all common areas and outdoor spaces,
- Replacing fossil fuel-based electric heating with renewable energy sources.

4.9.3 Evaluation of electricity production, transport and distribution means

4.9.3.1 Existing system

The following table shows the current electricity generation system on Lundy Island.

	3 diesel generators	**Solar thermal system**
Sector / power supply	Diesel	Solar
Site	North of the island's main group of buildings	Staff quarters building called The Lodges
Date of commissioning	2000	-
Connecting power / Capacity	140 kW, 140 kW and 80 kW	Estimated to 750 W

Table 25 - Existing system on Lundy Island

The three existing diesel generators thus cover most the island's electrical needs as well as the hot water used to heat most of the staff quarters. They are located to the north of the island's main group of buildings, in a series of small rooms contained within a larger workshop building. Next to the engines are a series of heat exchangers, compressors and pumps that facilitate the supply of hot water to the connected buildings. A 100-kW emergency boiler is also located in one of the small rooms in the workshop building. There are also two other small diesel generators, one providing local power to the air compressor in the boathouse located near the slipway on the south side of the island and the second at the lambing shed, which provides backup power in the event that the main generators fail.

Typically, of the three primary generators, only one or two engines operate at the same time, with the third engine serving as a backup in the event of an unscheduled shutdown of the other engine(s). The engines run for an average of 18 hours per day, from 6 to 12 hours, with a forced shutdown at night due to engine noise and for fuel economy. The 2017 energy assessment report estimates that approximately 350 litres of diesel are used per day by the generators. This estimate is based on the volumes of diesel supply brought to the island. In addition, no historical maintenance schedule for the diesel generators was established and the study protagonists only had access to limited anecdotal information on the general maintenance of the plant. Nevertheless, as the engines and associated equipment have been used daily and continuously for 17 years, the infrastructure was showing signs of wear in 2017. This was reflected in the frequency of maintenance tasks required by the island's engineer to keep the system running and the number of downtimes experienced by each engine. Their electrical efficiency is estimated at 40 per cent.

Furthermore, regarding the island's energy mix, in addition to generators, a small amount of gas is used for heating and cooking in some properties, but the study conducted estimates that this represents less than 4% of the total energy demand on the island. A small solar thermal system has also been installed in the newest staff accommodation building, The Lodges, to supplement the electric hot water system. The capacity of this system is unknown but is estimated at around 750 W depending on the size and arrangement of the panels.

The cable distribution system was also visually examined to the extent possible, but this did not provide specific information on the condition and safety of the cable system because the majority of the cable system was not visible. The study therefore recommends that a comprehensive report on the condition of the electrical installation (inspection of electrical wiring, circuits, accessories and connections) be carried out in the future by suitably qualified electrical engineers.

4.9.3.2 Evaluation of the market for innovative technologies

As explained in Johan Daelman's preliminary study, characterizing the Marine Renewable Energy (MRE) resource is an expert work generally attributed to research institutes. Having had a brief introduction to the different types of information needed to characterize renewable resources, the objective is now simply to identify the institutes able to provide this kind of data for different renewable resources with a strong interest in MRE. Where some information is provided by the institutes or other documentation, it will be presented to illustrate the summary table.

In addition, the research carried out in the framework of this study has made it possible to access a lot of information related to this part via studies already carried out, websites, scientific articles, etc. The results gathered and deemed relevant will also be presented to give the reader a more precise idea of the renewable energy potential of this NIA.

The following summary table presents the institutes able to deliver energy potential characterization data for each of the associated resources for Lundy Island.

Type of resource	Institutes able to deliver resource characterisation data
Tidal Energy from Tides Tidal Energy from currents Wave energy from waves Osmotic energy The thermal energy of the seas	The British Oceanographic Data Centre (BODC) is a national body responsible for the conservation and dissemination of data on the marine environment. It is the designated marine science data centre for the United Kingdom and is part of the National Oceanography Centre (NOC). It maintains and develops the National Oceanographic Database (NODB), whose marine data are mainly derived from UK research institutions. It manages the data of the UK Tide Gauge Network which is part of the National Tide & Sea Level Facility (NTSLF). The BODC is also one of six designated data centres that manage NERC environmental data. The United Kingdom Hydrographic Office (UKHO) is a UK agency that provides hydrographic and marine data to mariners and maritime organizations around the world.
Wind energy	The National Wind Speed (NOABL) database provides average wind speeds over a 1 km x 1 km area for the whole of the UK at heights of 10 m, 25 m and 45 m above ground. The meteoblue platform shares local weather data for the whole world with a resolution of 30 km. Among other things, wind roses are offered. For greater accuracy, they offer high-resolution simulations with data for every hour.
Solar energy	The EU Joint Research Centre's solar modelling software, PVGIS, estimates the potential for energy production that can be achieved by photovoltaic solar technology on the basis of average solar irradiation for a given geographical location. The Global Solar Atlas also provides quick and easy access to data on solar resources around the world.

Table 26 - Presentation of the institutes providing renewable resource data for Lundy island

According to the 2017 study, the use of available wind on Lundy Island for power generation is considered viable and an attractive option for the deployment of renewable energy production on the island, based on the analysis of the available wind resource with average wind speeds of 7.5, 8.2, 8.6 m/s for heights of 10, 25 and 45 metres respectively.

The PVGIS software indicates that a potential of 1050kWh/m2 of solar radiation is received at the latitude at which Lundy is located. In addition, the 2017 study had selected 2 suitable sites, described in the study report, for the development of small PV parks where the modules would be virtually unnoticed by the islanders. Indeed, on the island of Lundy, the preservation of the environment is a real concern and the implementation of technologies using renewable resources, in particular solar panels, will have to take this constraint into account.

Thus, the 2017 study has shown that Lundy has a good reserve of resources suitable for solar photovoltaic and onshore wind turbines. Nevertheless, taking into account the site-related constraints of deploying these technologies, the scope of deployment is limited to approximately 340 kW of solar photovoltaic and 60 kW of wind turbines.

In addition, hydropower on Lundy Island has also been considered. However, the island has only a few potential sites with natural sources or ponds, but none of them represent a significant flow for a hydropower project.

4.9.4 Evaluation of energy transition policies

4.9.4.1 Identification of local actors

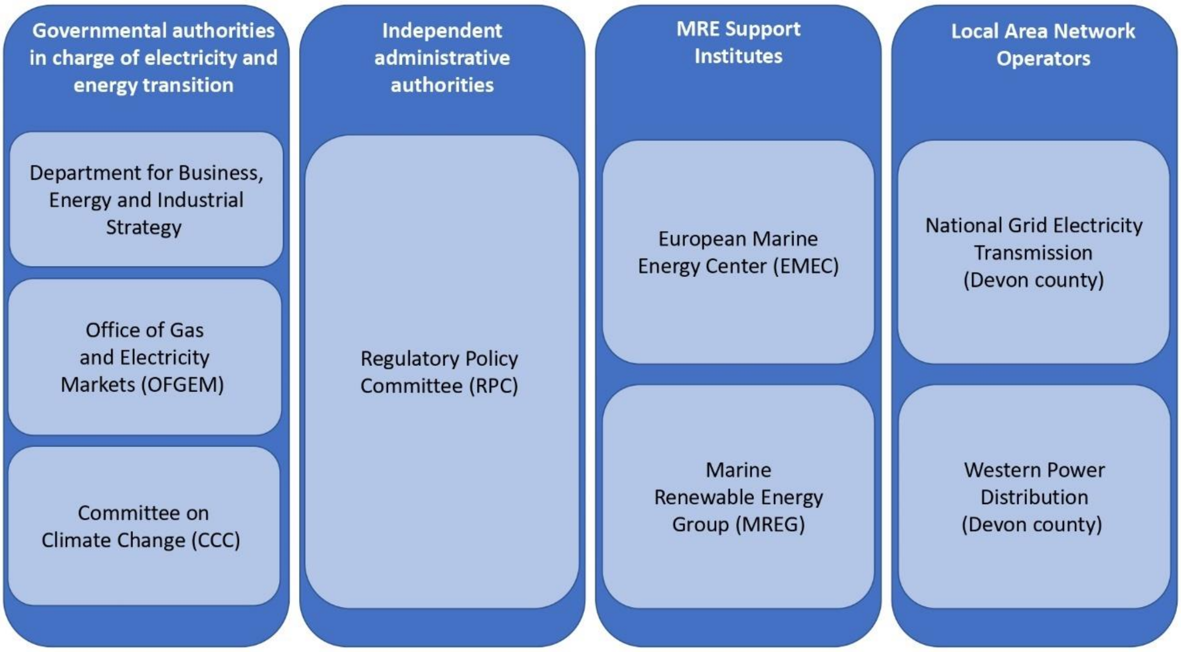


Figure 36 - Local actors of Lundy island

4.9.4.2 Identification of existing programmes and current energy transition policies

The island of Lundy, which has a population of about twenty people year-round but with more than a hundred people per busy day in summer, has very little information about its energy sector. The only relevant information available comes from the 2017 study provided by Aardvark EM Lt.

This energy audit of Lundy Island, which was finalized in February 2017 by Jack Spurway and Nicholas John, aimed to determine the demand for electricity on the island with a view to identifying areas for improvement in energy efficiency and, more broadly, to assess how to move from total dependence on diesel generators to alternative electricity supply technologies. Through field work with access to the island's existing infrastructure, they were able to calculate current and future electricity demand, identify various possible improvements, map and define existing electricity infrastructure, assess the potential for renewable energy production and make justified proposals in the short, medium and long term to enable the island to move away from dependence on fossil fuels. This audit was therefore a first step acting as a feasibility study. Several proposals were made but the MRE potential was not developed in a consistent manner. At present, there are no known programs underway

4.9.4.3 Assessment of the relevance of ongoing programmes and projects

The limited information available seems to indicate that currently no concrete energy transition policy has been established. The completion of the energy audit, together with the development of the actions carried out for the client, Landmark Trust and National Trust, nevertheless indicates that there is a willingness to change things in the future.

The island of Lundy therefore presents a future market with high potential for the implementation of means to boost its energy mix. However, this small island community seems to be resistant to any abrupt changes that are not environmentally friendly, so the population will first have to be convinced of the possible consequences of using certain systems and a collaborative effort with the inhabitants will obviously be necessary.

4.9.5 Contacts

Contacts for electricity supply and power grid management	*** Aardvarkem EM Ltd** (2017 case study energy assment Lundy Island) Email: environment@aardvarkem.co.uk - Nicholas Johnn Email: nicholasjohnn@aardvarkem.co.uk Phone number: 01984 624989 - Jack Spurway https://www.linkedin.com/in/jack-spurway-34b53963/
Competent local authorities	*** Lundy Island community** Phone number: 01237 431831 Email: general@lundyisland.co.uk ***National Trust et Landmark Trust** (environmental conservation association) Email: northdevon@nationaltrust.org.uk
Contacts able to support the implementation innovative energy solutions by companies	*** EMEC (The European Marine Energy Centre Limited)** Phone number: +44 (0)1856 852060 Email: info@emec.org.uk
Research institutes and other contacts able to transmit elements to characterise renewable resources	*** BODC:** https://www.bodc.ac.uk/data/all-data.html ***Platform of meteoblue:** https://www.meteoblue.com/fr/meteo/historyclimate/climatemodelled ***The National Wind Speed (NOABL) :** http://www.renew-reuse-recycle.com/noabl.pl?n=503 *** PVGIS:** https://ec.europa.eu/jrc/en/pvgis

	*** Global Solar Atlas:** https://globalsolaratlas.info/map *** Copernicus Climate Data Store:** https://cds.climate.copernicus.eu/cdsapp#!/home

Table 27 - Contacts for Lundy island

4.10 Eigg island - Île de Eigg [Scotland]

4.10.1 Island's presentation

The island of Eigg is in the Hebrides Sea, 11 kilometres off the Scottish coast. 100 people live on the island for a density of 3 inhabitants/km².

The island is electrically isolated from the mainland. It began its ecological transition in the 2000s and now takes advantage of the many renewable energy resources, namely wind, solar and sea (hydroelectric generators) to produce the majority of its electricity in a clean way, with a total production of 200kW.

The island also has two back-up 80 kW diesel generators. The main objective of the island is 100% renewable in the coming years.

4.10.2 Evaluation of electricity consumption

The production and management of the system is carried out using a Sunny webbox and an SMA Windy box. The data from these measuring devices is transmitted via the internet for remote management by the company Wind & Sun and the voluntary residents of Eigg. After several requests to Wind & Sun, they did not want to share the collected data. The only accessible data is the data on the Eigg Island case study on the Wind & Sun website.

4.10.3 Evaluation of electricity production, transport and distribution means

4.10.3.1 Existing system

Since 2008, the island of Eigg is equipped with a system that uses 100% renewable energy to supply electricity to the homes and businesses of its 87 inhabitants. The system is composed of several energy sources to ensure production stability.

	Diesel generator	Solar array	3 hydroelectric generators	Wind farm
Branch / Energy source	Diesel	Solar	Hydro	Wind
Date of commissioning	2008			
Capacity	60,7 kW	9,9 kW	6 kW, 6 kW and 100 kW	24 kW

Table 28 - Existing system on the island of Eigg

The storage system for the energy produced by the generators is made up of batteries managed by the Wind & Sun company. Electricity is now prepaid by residents and businesses: they buy cards entitling them to a certain amount of energy.

4.10.3.2 Evaluation of the market for innovative technologies

Below is a map of the sea currents around the island of Eigg, from ABPMer. The resolution is not high enough for a thorough study, but we can see that the currents are not very high around the island. An energy solution using an MRE solution is therefore not very appropriate.

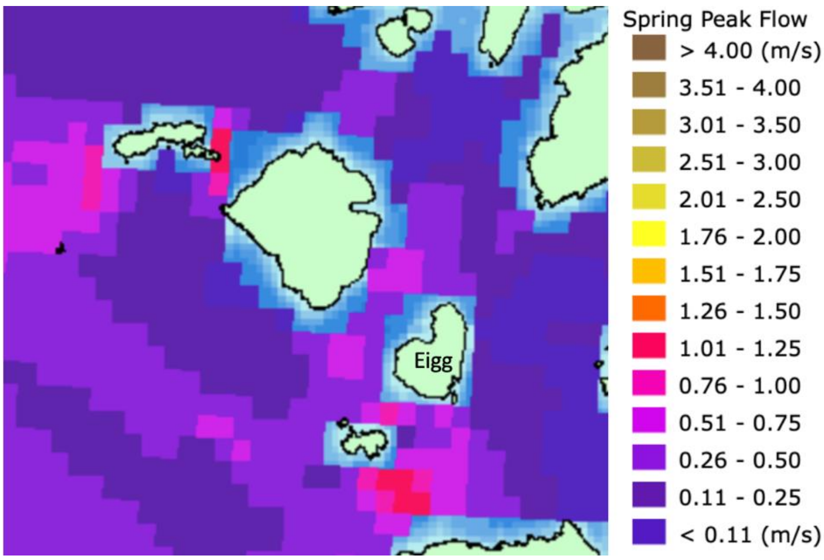


Figure 37 - Map of the currents around the island of Eigg

As explained in Johan Daelman's preliminary study, characterizing the Marine Renewable Energy (MRE) resource is an expert work generally attributed to research institutes. Having had a brief introduction to the different types of information needed to characterize renewable resources, the objective is now simply to identify the institutes able to provide this kind of data for different renewable resources with a strong interest in MRE. Where some information is provided by the institutes or other documentation, it will be presented to illustrate the summary table.

In addition, the research carried out in the framework of this study has made it possible to access a lot of information related to this part via studies already carried out, websites, scientific articles, etc. The results gathered and deemed relevant will also be presented to give the reader a more precise idea of the renewable energy potential of this NIA.

The following summary table presents the institutes able to deliver energy potential characterization data for each of the associated resources for Eigg Island.

<table>
<tr><th>Type of resource</th><th>Institutes able to deliver resource characterization data</th></tr>
<tr><td>Tidal Energy from Tides</td><td rowspan="5">The British Oceanographic Data Centre (BODC) is a national body responsible for the conservation and dissemination of data on the marine environment. It is the designated marine science data centre for the United Kingdom and is part of the National Oceanography Centre (NOC). It maintains and develops the National Oceanographic Database (NODB), whose marine data are mainly derived from UK research institutions. It manages the data of the UK Tide Gauge Network which is part of the National Tide & Sea Level Facility (NTSLF). The BODC is also one of six designated data centres that manage NERC environmental data.

The United Kingdom Hydrographic Office (UKHO) is a UK agency that provides hydrographic and marine data to mariners and maritime organizations around the world.</td></tr>
<tr><td>Tidal Energy from Currents</td></tr>
<tr><td>Wave Energy from Waves</td></tr>
<tr><td>Osmotic energy</td></tr>
<tr><td>Thermal energy from sea water</td></tr>
<tr><td>Wind energy</td><td>The National Wind Speed (NOABL) database provides average wind speeds over a 1 km x 1 km area for the whole of the UK at heights of 10 m, 25 m and 45 m above ground.

The meteoblue platform shares local weather data for the whole world with a resolution of 30 km. Among other things, wind roses are offered. For greater accuracy, they offer high-resolution simulations with data for every hour.</td></tr>
<tr><td>Solar energy</td><td>The EU Joint Research Centre's solar modelling software, PVGIS, estimates the energy production potential that can be realised by photovoltaic solar technology on the basis of average solar irradiation for a given geographical location.

The Global Solar Atlas also provides quick and easy access to data on solar resources around the world.</td></tr>
</table>

Figure 38 - Presentation of the institutes providing renewable resource data for Eigg island

4.10.4 Evaluation of energy transition policies

4.10.4.1 Identification of local actors

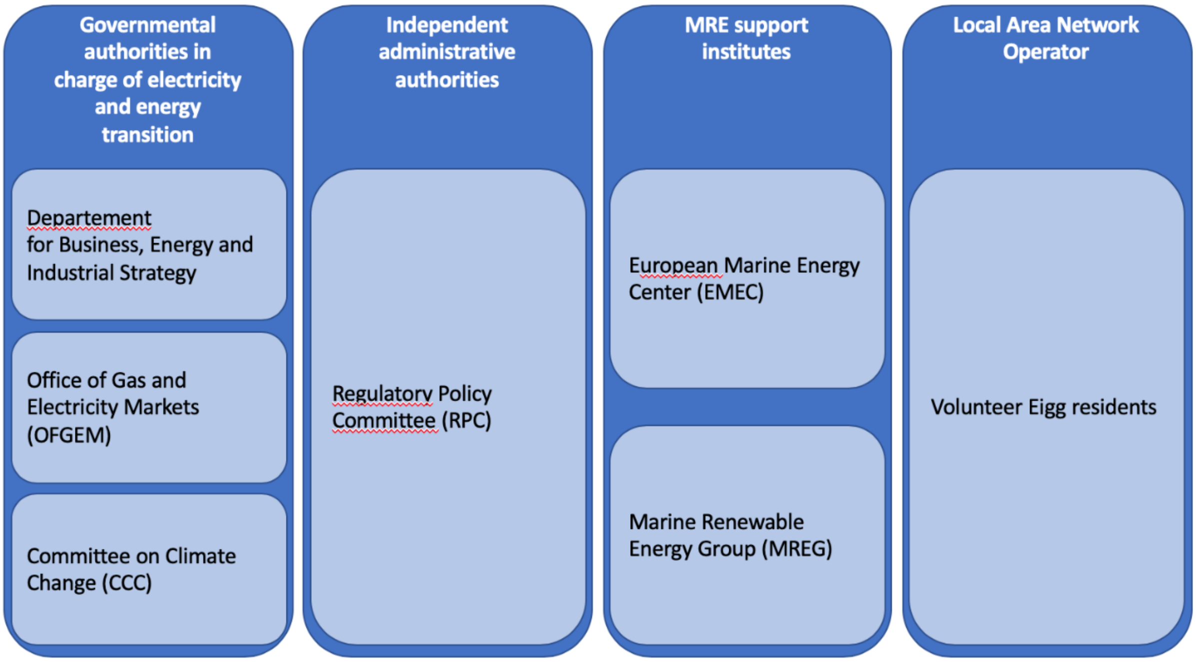


Figure 39 - Local actors of Eigg

4.10.4.2 Identification of existing programmes and current energy transition policies

The island of Eigg has completed its transition to renewables. When the island was bought out by the Isle of Eigg Heritage Trust, the community decided to get rid of the individual diesel generator and started the task of building an island electrical network. They managed to use the local resources efficiently and now produces more than 95% of their electricity with renewables. The rest of it is produced by a diesel generator that also ensures the stability of the network.

No other project has been implemented since the network was switched on in 2008.

4.10.4.3 Assessment of the relevance of ongoing programmes and projects

Because of the advanced state of the island concerning the use of renewable resources, no program is being developed. However, the stability of the network is provided by a diesel generator which could be fixed.

4.10.5 Contacts

Local authorities	* Île d'Eigg Web site: http://isleofeigg.org (contact via le site)

Table 29 - **Contacts for Eigg**

4.11 Rathlin island - Île de Rathlin [Northern Ireland]

4.11.1 Island's presentation

Rathlin Island, the only inhabited island in Northern Ireland, is less than 10 kilometres from the mainland. It is part of County Antrim and has a population of 150 inhabitants which is constantly increasing, with a population density of 9.9 inhabitants/km².

The island has been connected to the mainland electricity grid since 2007 by a submarine cable. However, the island is over 95% dependent on fossil fuels to meet its energy needs. The main fossil fuels transported to the island by ferry are diesel and kerosene used for heating, accounting for 285 000 litres and 290 000 litres per year respectively. The island's average annual emissions are 2,057 tonnes of $CO2$, with the two diesel-powered ferries producing over 800 tonnes of $CO2$ and kerosene heating 734 tonnes of $CO2$. The island also has a few solar panels with a power of 3.6 kW.

In addition, there is a very strong willingness on the part of the island and its inhabitants to move away from dependence on fossil fuels by favouring other renewable energy sources in order to achieve carbon neutrality and diversify its energy mix. Several energy audits have already been carried out and have provided a baseline for future energy transition paths. Rathlin Island has a huge potential in terms of renewable resources such as wind power, photovoltaic energy, marine energy and biomass.

4.11.2 Evaluation of electricity consumption

4.11.2.1 Electricity consumption on the island

The data below is from a thesis done by a student at Queen's University of Belfast as part of his engineering degree in environmental engineering. This document was provided by the Rathlin Development & Community Association (RDCA) and the data may be used "without special permission" as indicated on the cover page of the document.

The data for the different electricity consumption is from NIE (Northern Ireland Electricity) as indicated in the thesis. Nevertheless, electricity currently represents only a small part of the total energy demand of the island with 8%.

First of all, the first figure shows the evolution of the annual electricity consumption of the island of Rathlin compared to the annual electricity consumption of Northern Ireland from 2013 to 2018.

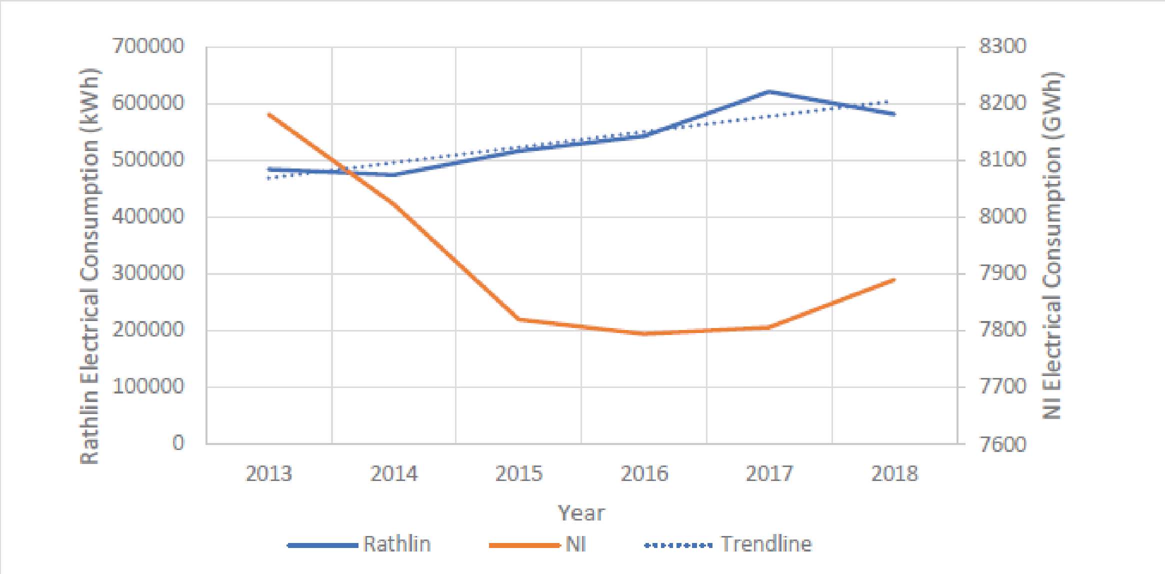


Figure 40 - Evolution of the annual electricity consumption of the island of Rathlin compared to the annual electricity consumption of Northern Ireland from 2013 to 2018

The annual electricity consumption of the island of Rathlin has gradually increased until 2017 to reach a little over 600 MWh and then, as explained in the thesis, it decreased in the year 2018 to reach 580 MWh. The increase in electricity demand can be explained by the growth of the island's population, which has seen an increase in the number of tourists (+13%) (NISRA, 2018). Nevertheless, although the population has increased by almost 50%, electricity consumption has not increased by the same factor. This may be due to improvements in electrical efficiency or dependence on other fuel sources, but annual increases in demand for other fuel sources are not available for the island.

The following figure shows the evolution of electricity consumption on Rathlin Island, highlighting seasonal trends over the period February 2018 to February 2019. This electricity consumption is again compared to that of Northern Ireland.

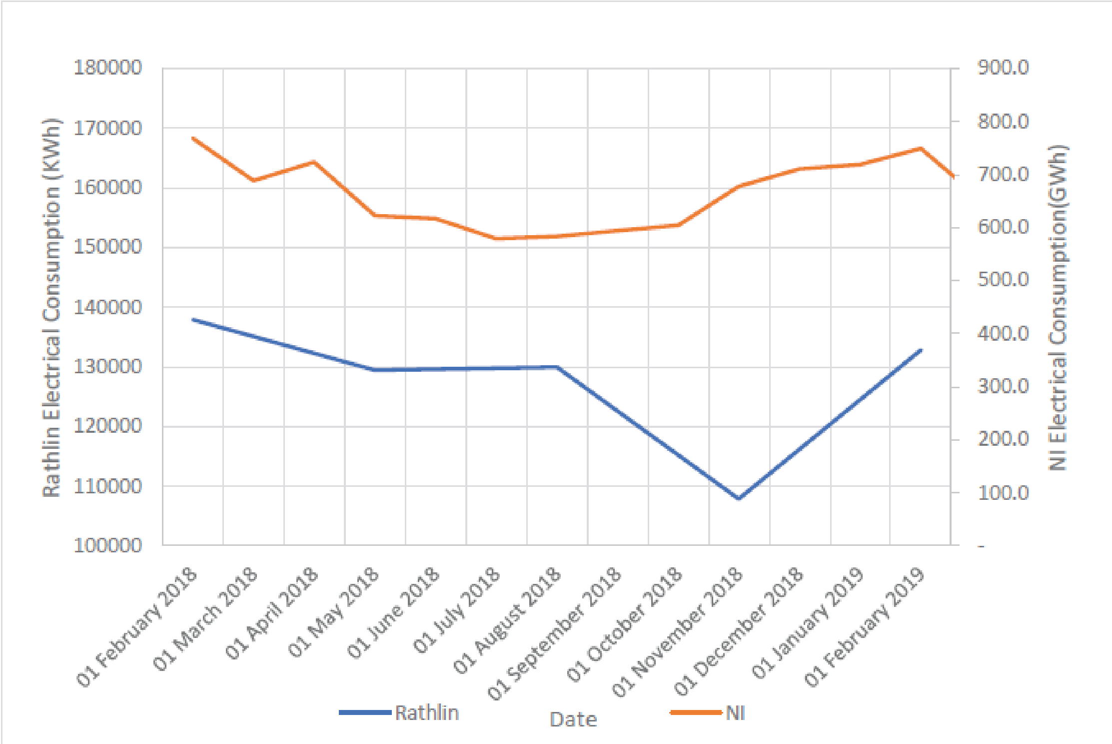


Figure 41 – Monthly trend in electricity consumption on the island of Rathlin compared to Northern Ireland (February 2018 - February 2019)

Power consumption does not fluctuate strongly with extremely distant peaks. Rather, it is a gradual trend with an increase in electricity consumption in winter to reach monthly consumption levels slightly lower than 170 MWh and a decrease in summer to over 150 MWh per month.

The following figure shows daily electricity consumption on Rathlin Island as a function of the seasons. The island has 6 half-hourly recording sites, these sites are mainly linked to public services such as the Northern Ireland Water Pumping Stations, BT (British Telecom) and PSNI (Police Service Northern Ireland) communication masts. Data for the 6 sites were provided for each 30-minute interval during the year 2018. The 6 sites vary considerably in terms of consumption on a daily and hourly basis. The data for the 6 sites was compiled with a total consumption for the 6 sites of 82,000 kWh, or 14% of the total electrical load of the island in 2018.

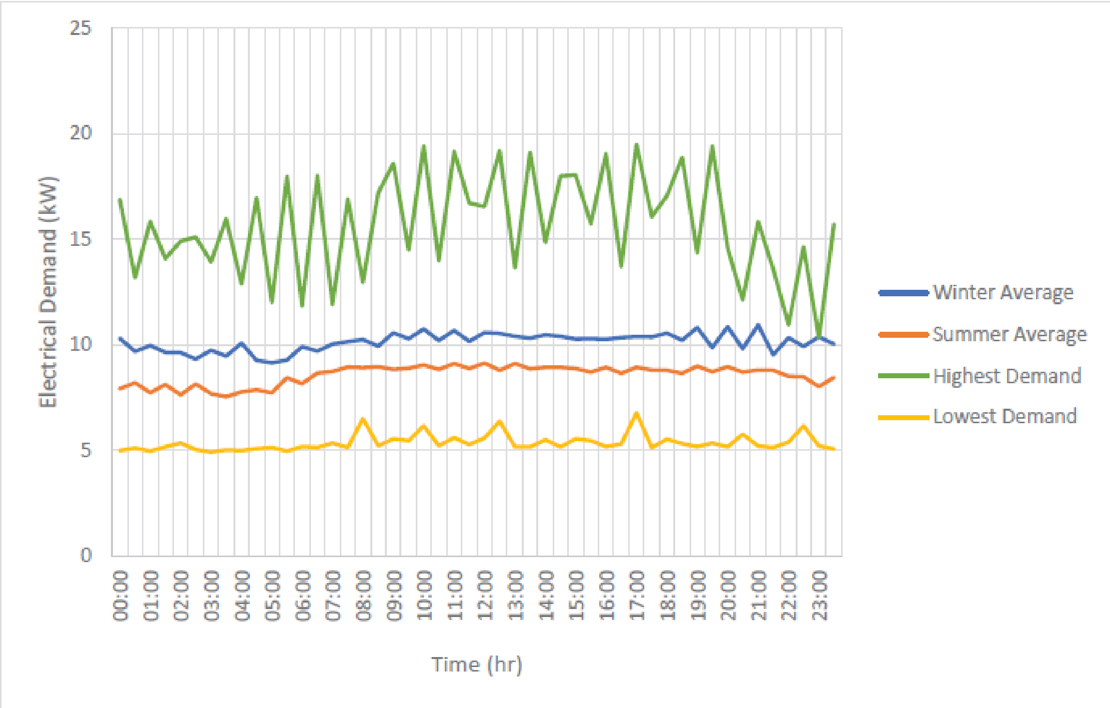


Figure 42 - Evolution of the daily electricity consumption of the island of Rathlin according to the seasons

The hourly demand on an average winter day and an average summer day shows an average difference of 15%. Moreover, the highest electricity demand occurred on January 6, 2018, a day that contrasts sharply with July 27, 2017, which represents the lowest demand in 2018. The difference amounts to 66%.

The half-hourly data from the 6 sites were also analysed in terms of daily consumption. Consumption varies considerably from one site to another, but when the consumption was compiled the data resembled a typical daily consumption throughout the year as shown in the following figure.

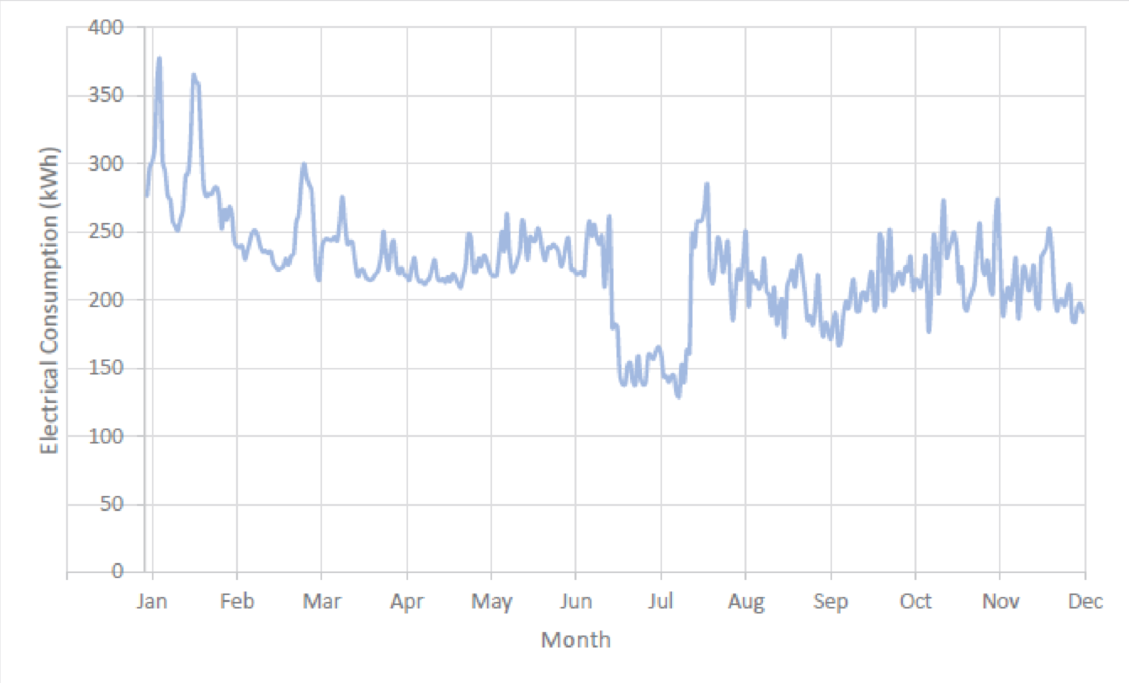


Figure 43 - Evolution of the monthly electricity consumption of Rathlin Island from 6 sites

The highest levels of demand occur in winter, during the month of January. The lowest levels of demand occur during the summer months of June and July. Nevertheless, this figure is in slight contradiction with the daily consumption for the whole island shown in the figure showing the evolution of monthly electricity consumption. Indeed, the increase in electricity consumption is less noticeable in the previous figure from October onwards. However, these data are collected from points all around the island and may not represent the busiest area around Church Bay during the high summer season, which accounts for more than 85% of total electricity consumption.

The following figure represents the proportion of each sector of activity in Rathlin Island's electricity consumption for the year 2018.

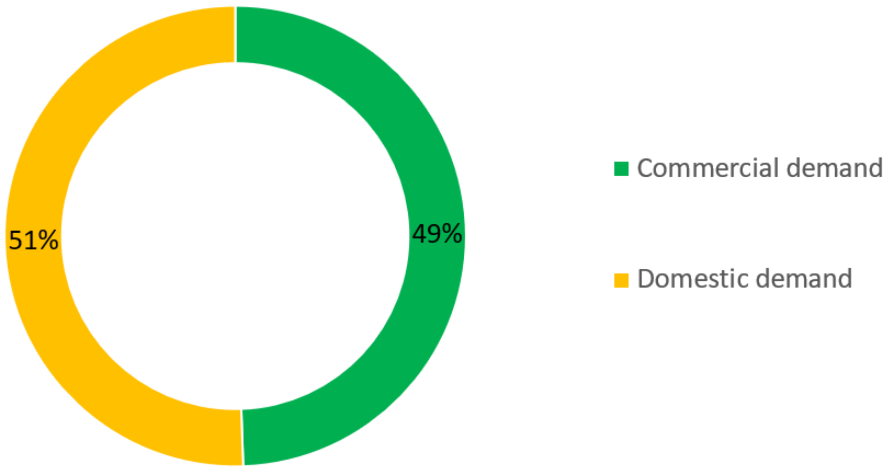


Figure 44 - Electricity consumption by sector of activity on Rathlin Island (2018)

The island has 128 electrical connection points, 101 domestic and 27 commercial or community. Total domestic electricity consumption in 2018 was 322,470 kWh and commercial demand was 315,490 kWh. The average electricity consumption of all domestic units over the 12 months concerned was calculated on the basis of quarterly data from 20/02/2018 to 26/02/2019 and amounted to 3,193 kWh. However, these data may be distorted by the high percentage of tourists. In fact, six units had an electricity consumption of less than 100 kWh during this period. As explained in the thesis paper, assuming that the 14 lowest domestic energy consumers are correlated with the holiday homes, and excluding their consumption, the average domestic electricity consumption rose to 3,666 kWh. These tourist activities on the island also result in a higher demand for electricity than the needs of the autumn.

Concerning electricity consumption by geographical area, the most populated area of the island is around Church Bay and accounts for more than 85% of total electricity consumption.

4.11.2.2 Consumption patterns

The following section aims to present the consumption pattern of Rathlin Island. For the moment, it seems that no measures have been put in place to address the problem of energy-intensive activities. Nevertheless, the thesis document gives an overview of the different measures that should be applied to reduce certain energy losses.

Since heating accounts for 86% of the total domestic demand on the island, any reduction in this area would therefore significantly reduce the consumption and total cost of energy for domestic dwellings. The author sets out a number of measures, such as replacing old boilers with newer, more efficient ones, replacing single-glazed windows with double-glazed windows, and undertaking renovation work on housing, including insulation. In addition, with regard to lighting, it also suggests replacing current light bulbs with LEDs in order to reduce electricity consumption.

These measures would be all the more effective as island households also consume on average more than 40% more energy than mainland households. Moreover, as the following figure shows, Rathlin Island homes are relatively old, so they are likely to be more difficult to heat and less energy efficient than newer homes.

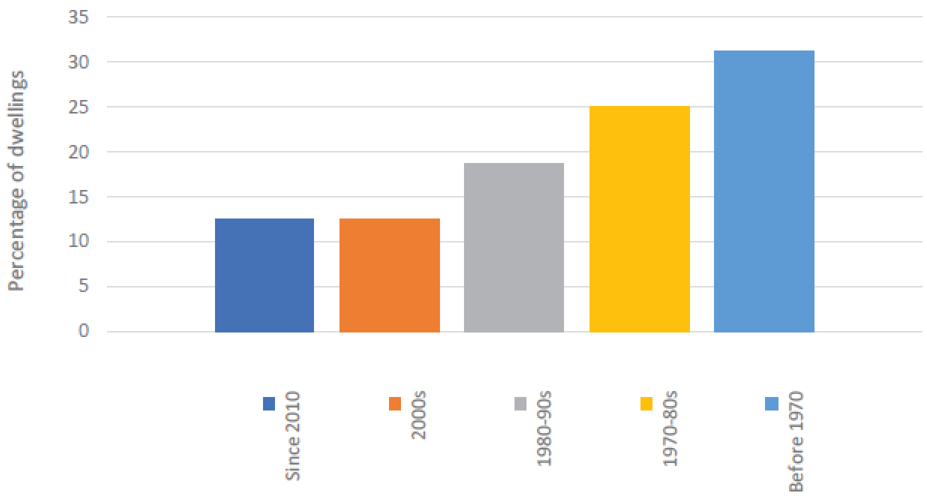


Figure 45 - Distribution of the different dwellings on Rathlin Island according to their seniority

4.11.3 Evaluation of electricity production, transport and distribution means

4.11.3.1 Existing system

The following table shows the current electricity generation system on Rathlin Island.

	Photovoltaic panels
Sector / power supply	Solar
Producer	-
Site	Administrative building of the RDCA and on a housing unit
Date of commissioning	-
Connecting power / Capacity	Not available

Table 30 - Current electricity generation system on the Island of Rathlin

Little information is available on the island's power generation systems. For photovoltaic panels, production data are not available as indicated in the thesis document used. Moreover, as the island is connected to the North Irish mainland by a 10.4-kilometre underwater power cable, this certainly explains the low number of power generation systems on the island despite its current intentions.

4.11.3.2 Evaluation of the market for innovative technologies

As explained in Johan Daelman's preliminary study, characterizing the Marine Renewable Energy (MRE) resource is an expert work generally attributed to research institutes. Having had a brief introduction to the different types of information needed to characterize renewable resources, the objective is now simply to identify the institutes able to provide this kind of data for different renewable resources with a strong interest in MRE. Where some information is provided by the institutes or other documentation, it will be presented to illustrate the summary table.

In addition, the research carried out in the framework of this study has made it possible to access a lot of information related to this part via studies already carried out, websites, scientific articles, etc. The results gathered and deemed relevant will also be presented to give the reader a more precise idea of the renewable energy potential of this NIA. The figures from the different institutes will be presented in the appendix for a better readability of the report.

The following summary table presents the institutes able to provide energy potential characterization data for each of the associated resources for Rathlin Island.

Type of resource	Institutes able to deliver resource characterisation data
Tidal Energy from Tides	A scientific study was conducted to model and characterize the potential of the hydrological resource on Rathlin Island. Reference: Pérez-Ortiz et al / Renewable Energy 114 (2017) - "Characterization of the tidal resource in Rathlin Sound". The British Oceanographic Data Centre (BODC) is a national body responsible for the conservation and dissemination of data on the marine environment. It is the designated marine science data centre for the United Kingdom and is part of the National Oceanography Centre (NOC). It maintains and develops the National Oceanographic Database (NODB), whose marine data are mainly derived from UK research institutions. It manages the data of the UK Tide Gauge Network which is part of the National Tide & Sea Level Facility (NTSLF). The BODC is also one of six designated data centres that manage NERC environmental data. The United Kingdom Hydrographic Office (UKHO) is a UK agency that provides hydrographic and marine data to mariners and maritime organizations around the world.
Tidal Energy from currents	
Wave energy from waves	
Osmotic energy	
The thermal energy of the seas	
Wind energy	The National Wind Speed (NOABL) database provides average wind speeds over a 1 km x 1 km area for the whole of the UK at heights of 10 m, 25 m and 45 m above ground. The meteoblue platform shares local weather data for the whole world with a resolution of 30 km. Among other things, wind roses are offered. For greater accuracy, they offer high-resolution simulations with data for every hour.
Solar energy	The EU Joint Research Centre's solar modelling software, PVGIS, estimates the potential for energy production that can be achieved by photovoltaic solar technology on the basis of average solar irradiation for a given geographical location. The Global Solar Atlas also provides quick and easy access to data on solar resources around the world.

Table 31 - Presentation of the institutes providing renewable resource data for Rathlin island

The study by Perez-Ortiz et al (2017) estimated the maximum extractable power at 330 MW near Rathlin Island.

In addition, although there are a number of small water sources on Rathlin Island, hydropower was found to be unsustainable on the island due to low flows (RDCA 2019).

In addition, Rathlin Island and the north-east coast of Ireland have been identified as areas with some of the highest geothermal potential in Ireland (Goodman et al., 2004). Using existing oil and gas drilling data, the deep geothermal potential at 2.5 km below ground level was found to be 99.5°C at Port More. Models by Goodman et al (2004) estimated similar temperatures 2.5 km below Rathlin. The Sherwood sandstone formation located between 1830 and 1150 m below ground level at Port More has an estimated thermal energy reserve of 5.24x10^9 kJ. The total energy stored in the reservoir is conservatively estimated at 1456 MWh/year. This thermal energy has the potential to be used for district heating on Rathlin (Pasquali et al., 2010).

4.11.4 Evaluation of energy transition policies

4.11.4.1 Identification of local actors

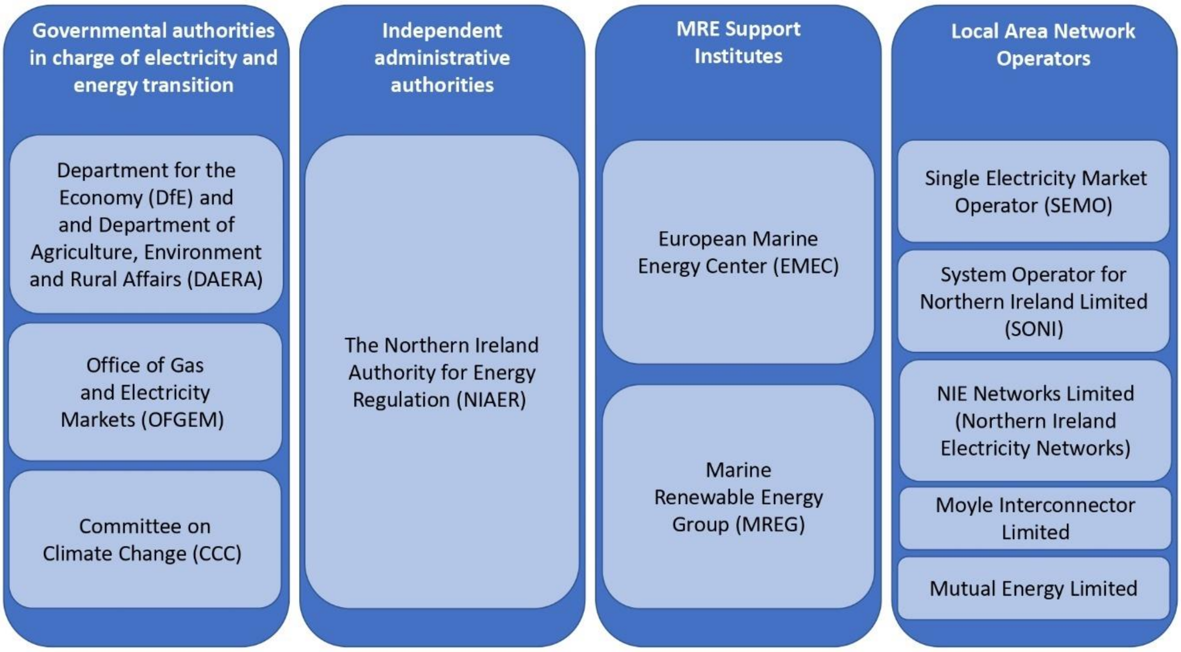


Figure 46 - Local actors of Rathlin Island

4.11.4.2 Identification of existing programmes and current energy transition policies

Rathlin Island is part of The Clean Energy for EU Islands, a European network that supports island communities wishing to develop and implement an approach to their transition to clean energy that brings together all relevant stakeholders on the island, including civil society organisations, local authorities, local businesses, schools and universities.

Indeed, in May 2017, the European Commission, together with 14 member States, signed a declaration entitled "Political Declaration on Clean Energy for EU Islands".

This declaration was born out of the recognition that islands and island regions face a range of energy challenges and opportunities due to their geographical and climatic conditions. These opportunities have the potential to make Europe's island communities leaders in innovation in the transition to clean energy for Europe. Thus, in cooperation with the European Parliament, the European Commission subsequently established in 2018 this European network "The Clean Energy for EU Islands", which acts as a platform for the exchange of best practices for island stakeholders and provides specific advisory and capacity building services.

Regarding Rathlin Island's energy policies, since its connection to the electricity grid in 2007 by a submarine cable, there has been a strong desire to produce renewable energy on the island and to move towards carbon neutrality. The Rathlin Development & Community Association (RDCA) began exploring options in early 2008, initially focusing on a community-owned wind turbine.

However, the implementation of this wind turbine was delayed for several years and this ambition was stalled for the following reasons; firstly, in 2008 an environmental impact assessment was required, which led to the production of a full environmental statement. At that time, the RDCA had little or no funds to professionally produce the many chapters of this declaration, and therefore began to call for volunteer support to bring the work together. By 2015, Rathlin was able to submit a full application to the planning department, but his request was turned down by planners because of the potential negative impact on tourism. As a result, a survey was carried out among more than 400 tourists visiting the island. 95% of the visitors surveyed were not opposed to the installation of a community wind turbine on the island, and a full building permit was obtained in mid-2016. Unfortunately, between the time the application was submitted, and the permit was obtained, the Northern Ireland Executive withdrew its support for the Renewable Obligation Certificate (ROC), in line with Conservative Government policy in Britain, weakening the financial business case for the community project.

Rathlin's desire to transform itself into a fully green economy has remained constant throughout this long and arduous process and has always been at the forefront of Rathlin's policy and associated action plans. The RDCA took advantage of the support of the ROC to install a small photovoltaic system (3.6 kW) on the Resource Centre. The island also intends to install an all-electric heating system to replace the existing small oil-filled electric radiators. Rathlin's policy, approved by the Northern Ireland Executive in February 2010, states that one of its strategic objectives is to develop Rathlin as a carbon neutral island producing electricity from renewable sources.

In line with this intention, an energy audit of Rathlin Island was carried out in October 2019. It was commissioned by the RDCA in collaboration with the Ministry of Economy (DfE), through the Rathlin Ministerial Policy Forum, and prepared by a master’s student, Michael McElrone, from Queen's University Belfast.

This recent audit provided a baseline that will be used to explore energy reduction options and alternatives. The island community is committed to implementing the various viable options to finally begin an energy and environmental transition.

4.11.4.3 Assessment of the relevance of ongoing programmes and projects

The island of Rathlin therefore represents a huge potential market for potential companies active in the field of energy transition. Indeed, Rathlin is blessed with abundant renewable resources on land, sea, air and underground, and the island is determined to take advantage of them in the future. Islanders are currently in discussions with business support organizations to facilitate a full feasibility study of renewable options for the island. They are also studying the growing development of hydrogen-based fuels and the options that this may offer in the short to medium term, particularly for the two ferries, and with a view to possible future hydrogen production on the island.

The community's most immediate challenge is to secure the funding and services needed for a comprehensive feasibility study on energy reduction and renewable options. Funding has been a major concern for the island in the past, as they have found that grants for community-based renewable solutions available elsewhere in the UK have not been extended to Northern Ireland. However, with the growing support of the Rathlin Ministerial Policy Forum, this issue could be addressed through a commercial feasibility study and subsequent facilitation funding.

4.11.5 Contacts

Contacts for electricity supply and power grid management	*** Northern Ireland Electricity (NIE) Networks** (owns and maintains Northern Ireland's electricity networks) Phone number: 03457 643 643 Website: https://www.nienetworks.co.uk/home
Competent local authorities	*** Rathlin Development and Community Association (RDCA)** Phone number (office): 028 2076 0079 Phone number (mobile): 078 5032 7456 Email: rdcaoffice@gmail.com http://www.rathlincommunity.org/
Contacts able to support the implementation innovative energy solutions by companies	***The Clean Energy for EU Islands** Email: info@euislands.eu Phone number: +32 2 400 10 67 *** EMEC (The European Marine Energy Centre Limited)** Phone number: +44 (0)1856 852060 Email: info@emec.org.uk
Research institutes and other contacts able to transmit elements to characterise renewable resources	*** BODC:** https://www.bodc.ac.uk/data/all-data.html ***Platform of meteoblue:** https://www.meteoblue.com/fr/meteo/historyclimate/climatemodelled ***The National Wind Speed (NOABL) :** http://www.renew-reuse-recycle.com/noabl.pl?n=503 *** PVGIS:** https://ec.europa.eu/jrc/en/pvgis *** Global Solar Atlas:** https://globalsolaratlas.info/map *** Copernicus Climate Data Store:** https://cds.climate.copernicus.eu/cdsapp#!/home

Table 32 - Contacts for Rathlin Island

4.12 Clare island - Île de Clare [Ireland]

4.12.1 Island's presentation

The Island of Clare, in County Mayo in Ireland, is located 5 kilometres from the nearest coastline in the west of the country. There are 159 inhabitants living on the island on a permanent basis, giving the island a density of 8 inhabitants/km². The island is entirely Irish and therefore answerable to its government.

There is an underwater electric cable that connects it to the mainland, so it is not electrically insulated. We have not found any information on local renewable energy production. However, being dependent on this cable, the island wishes to move towards renewable energy production.

4.12.2 Evaluation of electricity consumption

4.12.2.1 Electricity consumption on the island

Despite the requests and reminders to the contacts we provided for this island, we did not have access to the island's consumption by sectors and categories of consumers.

4.12.2.2 Consumption patterns

The island's main economic activities are tourism and a small fishing and farming industry, so most of the the island's consumption is due to residential buildings, especially in the summer period when bed and breakfasts are occupied by travellers.

4.12.3 Evaluation of electricity production, transport and distribution means

4.12.3.1 Existing system

The following table outlines the current electricity generation system on the Island of Clare

	Submarine cable
Energy source	Unknown
Producer	ESB
Site	Louisburgh
Date of commissioning	?
Connection power (kW) / Capacity	Unknown

Table 33 - Current electricity generation system on the Island of Clare

The submarine cable linking the island and Louisburgh brings and supplies all the power needed to Clare. It is also likely that there are backup generators in case the cable is under maintenance or breaks down, however, we have not found evidence of such large-scale installations.

4.12.3.2 Evaluation of the market for innovative technologies

As explained in Johan Daelman's preliminary study, characterizing the Marine Renewable Energy (MRE) resource is an expert work generally attributed to research institutes. Having had a brief introduction to the different types of information needed to characterize renewable resources, the objective is now simply to identify the institutes able to provide this kind of data for different renewable resources with a strong interest in MRE. Where some information is provided by the institutes or other documentation, it will be presented to illustrate the summary table.

In addition, the research carried out in the framework of this study has made it possible to access a lot of information related to this part via studies already carried out, websites, scientific articles, etc. The results gathered and deemed relevant will also be presented to give the reader a more precise idea of the renewable energy potential of this NZI.

The following summary table presents the institutes able to provide characterization data of the energy potential for each of the associated resources.

Type of resource	Institutes able to deliver resource characterization data
Tidal Energy from Tides	Tide Institute: https://www.tidetimes.org.uk
Other energy sources (tidal, wave, wind, solar, osmotic and thermal)	Data base ERA-5 and ERA Interim

Table 34 - Presentation of the institutes providing renewable resource data for Clare

4.12.4 Evaluation of energy transition policies

4.12.4.1 Identification of local actors

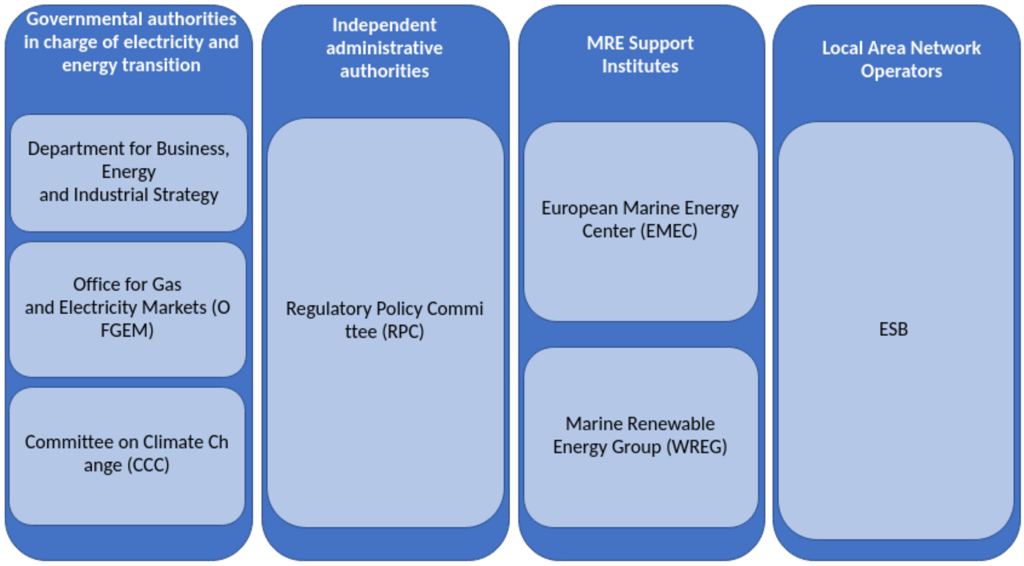


Figure 47 - Local actors of Clare island

4.12.4.2 Identification of existing programmes and current energy transition policies

At the present time and based on all the data we had access to for this study, there are no major renewable energy development programs on the Island of Clare.

4.12.4.3 Assessment of the relevance of ongoing programmes and projects

At the present time and based on all the data we had access to for this study, there is no major renewable energy development program on the Island of Clare.

4.12.5 Contacts

Contacts for electricity supply and network management	* Electricity producer: **ESB** web: https://www.esb.ie Tél: 1850 372 757 Mail : esbnetworks@esb.ie
Competent local authorities	* **Clare Island Ferry Company** Tél : +353 86 851 5003 Mail : info@clareisland.info Web : https://clareisland.info

Contacts able to support the implementation of innovative energy solutions by companies	* Electricity producer: **ESB** web: https://www.esb.ie Tél: 1850 372 757 Mail : esbnetworks@esb.ie
Research institutes and other contacts able to transmit elements to characterize renewable resources	* Meteoblue : https://www.meteoblue.com/fr/meteo/historyclimate/climatemodelled/ouessant_france_6618260 *The National Wind Speed (NOABL) : http://www.renew-reuse-recycle.com/noabl.pl?n=503 * Global Solar Atlas: https://globalsolaratlas.info/map * Copernicus Climate Data Store: https://cds.climate.copernicus.eu/cdsapp#!/home

Table 35 - Contacts for Clare island

4.13 Inishmore, Archipel des îles – Aran Islands [Ireland]

4.13.1 Island's presentation

The island of Inishmore is in Galway County in Ireland, 8 kilometres off the coast. The island has a permanent population of 840 inhabitants and a population density of 27 inhabitants/km². The island is entirely Irish and therefore depends on its government.

There is a single 3 MW submarine cable connected to the island, which can break down and thus cut off all power on the island for the time it takes to search for a fault and repair it. There are oil power generators on the archipelago that can provide 9,040,500 MWh for the entire archipelago. In 2017, the island imported 1855 MWh of electricity, 5622 MWh of oil and 12,93 MWh of petrol for transportation, including 9541 MWh for the ferry alone which cost over 250,000 euros.

The island of Inishmore wishes to begin its transition to renewable energy by looking at RME, photovoltaic and other renewable sources of production.

4.13.2 Evaluation of electricity consumption

4.13.2.1 Electricity consumption on the island

Inishmore Island's electricity consumption is essentially the same throughout the year. There is a slight decrease during the summer months as it requires less energy overall.

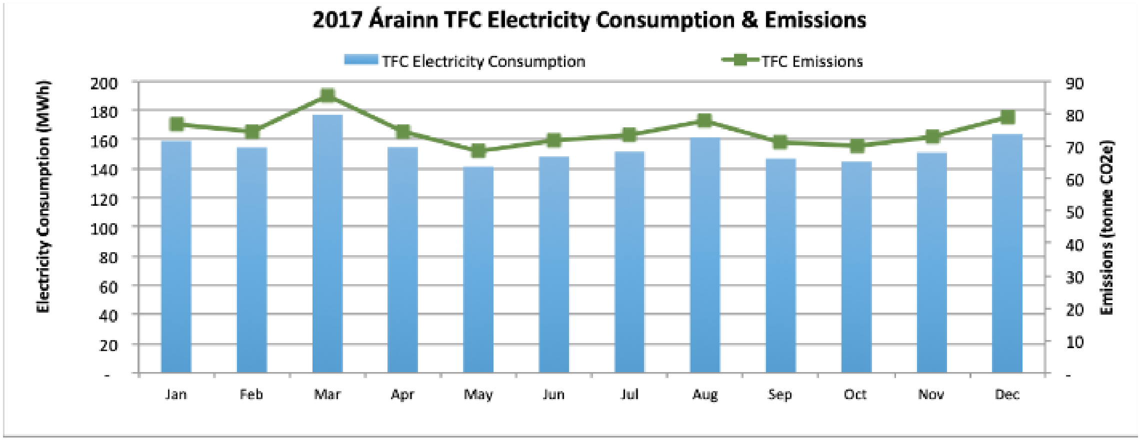


Figure 48 - Inishmore annual Consumption

4.13.2.2 Consumption by consumer category and geographic area

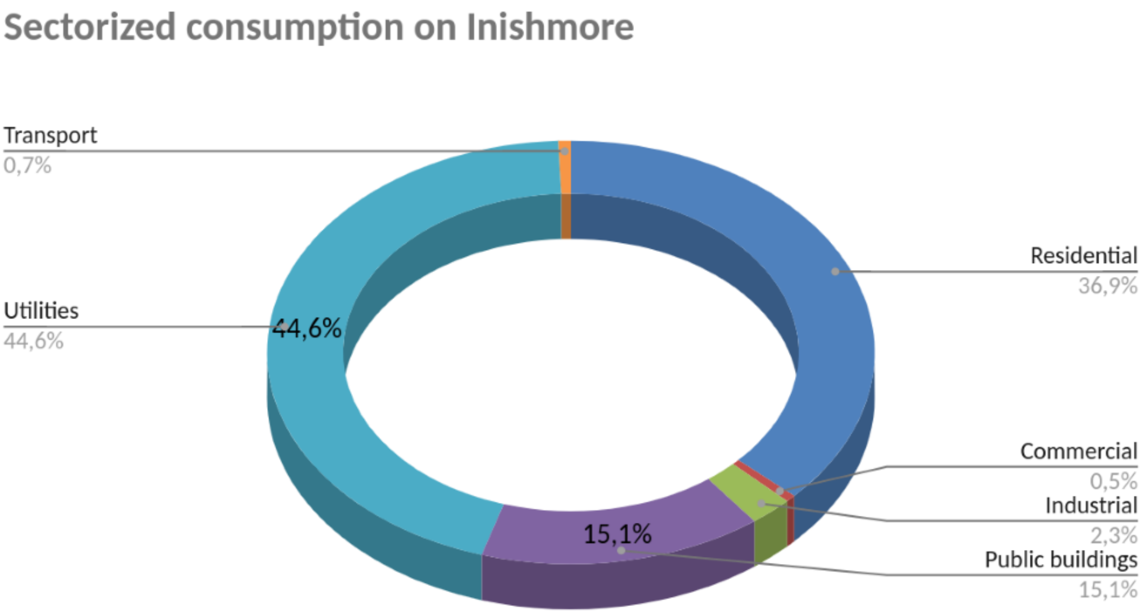


Figure 49 - Sectorized consumption on Inishmore

4.13.2.3 Consumption patterns

Electricity consumption on the island of Inishmore has the peculiarity that it depends entirely, in theory, on the submarine cable managed by the company ESB.

This dependence is a problem for the inhabitants. Indeed, the losses due to the cable are globally quite important, which causes power cuts from time to time. In addition, this kind of installation is quite expensive and requires a lot of maintenance.

Thus, in the event of a break or major problem with the cable, the houses are connected to oil-fired generators, which, in return for having to transport fuel oil from the ground and polluting by gas emissions, allow a constant flow rate.

4.13.3 Evaluation of electricity production, transport and distribution means

4.13.3.1 Existing system

The following table outlines the current electricity generation system on Inishmore Island

	Submarine cable
Energy source	Submarine cable
Producer	ESB
Connecting power (kW) / Capacity	212

Table 36 - Current electricity generation system on the Island of Inishmore

4.13.3.2 Evaluation of the market for innovative technologies

As explained in Johan Daelman's preliminary study, characterizing the Marine Renewable Energy (MRE) resource is an expert work generally attributed to research institutes. Having had a brief introduction to the different types of information needed to characterize renewable resources, the objective is now simply to identify the institutes able to provide this kind of data for different renewable resources with a strong interest in MRE. Where some information is provided by the institutes or other documentation, it will be presented to illustrate the summary table.

In addition, the research carried out in the framework of this study has made it possible to access a lot of information related to this part via studies already carried out, websites, scientific articles, etc. The results gathered and deemed relevant will also be presented to give the reader a more precise idea of the renewable energy potential of this NZI.

The following summary table presents the institutes able to provide characterization data of the energy potential for each of the associated resources.

Type of resource	Institutes able to deliver resource characterization data
Tidal Energy from Tides	Tide Institute: https://www.tidetimes.org.uk
Other forms of energy (tidal, wave, wind, solar, osmotic and thermal energy, etc.)	Data base ERA-5 and ERA Interim

Table 37 - Presentation of the institutes providing renewable resource data for Inishmore

4.13.4 Evaluation of energy transition policies

4.13.4.1 Identification of local actors

Governmental authorities in charge of electricity and energy transition	Independent administrative authorities	MRE Support Institutes	Local Area Network Operators
Department for Buisness, Energy and Industrial Strategy	Regulatory Policy Committee (RPC)	European Marine Energy Center (EMEC)	Aran Islands Energy Cooperative
Office for Gas and Electricity Markets (OFGEM)		Marine Renewable Energy Group (WREG)	
Committee on Climate Change (CCC)			

Table 38 – Local actors for Inishmore

4.13.4.2 Identification of existing programmes and current energy transition policies

The island of Inishmore, in the Aran Islands archipelago, wants to make a major energy transition in the coming years in order to achieve total energy dependence by 2025. Having to depend on an underwater power cable connected to Ireland, which can and has already had problems (voltage drop) causing power cuts on the island, as well as having to depend on importing fuel oil to the island, are two drivers for the creation of transition programmes.

The Aran Islands have formed the Aran Islands Energy Cooperative in order to be able to locally support the inhabitants in making an energy transition and raise awareness of sustainable solutions. This cooperative is working on the development of a wind farm that can produce 2.7MW. However, it is encountering difficulties in terms of connection, planning etc.

4.13.4.3 Assessment of the relevance of ongoing programmes and projects

Faced with its difficulties of implementation, tariff integration, connection to the grid, the project to set up a wind farm on the island of Inishmore is not yet in place and mounted on the island. Most of the energy production is still supplied at 93% by coal, diesel, gasoil, and kerosene.

The island is still in contact with several organisations such as Galway-Mayo Institute of Technology (GMIT) and Galway University (NUIG) to discuss future installations.

4.13.5 Contacts

Contacts for electricity supply and power grid management	* Electricity generator: ESB Website: https://www.esb.ie Local number: 1850 372 757 Mail: esbnetworks@esb.ie
Contacts able to support the implementation innovative energy solutions by companies	* Aran Islands Energy Cooperative Website: http://www.aranislandsenergycoop.ie Mail: comharchumannfuinnimh@gmail.com
Research institutes and other contacts able to transmit elements to characterize renewable resources	* BODC: https://www.bodc.ac.uk/data/all-data.html * Meteoblue : https://www.meteoblue.com/fr/meteo/historyclimate/climatemodelled/ouessant_france_6618260 *The National Wind Speed (NOABL) : http://www.renew-reuse-recycle.com/noabl.pl?n=503 * PVGIS: https://ec.europa.eu/jrc/en/pvgis * Global Solar Atlas: https://globalsolaratlas.info/map * Copernicus Climate Data Store: https://cds.climate.copernicus.eu/cdsapp#!/home

Table 39 - Contacts for Inishmore

4.14 Cape Clear Island [Ireland]

4.14.1 Island's presentation

Cape Clear Island is an Irish island in County Cork, 12 kilometres off the coast of Ireland. It has 125 year-round inhabitants and a population density of 19 inhabitants/km².

It is connected to the coast by a single submarine cable and, like many Irish islands, wishes to move towards a non-dependent electricity supply from the mainland. As for the production for its gas and heating, the island imports coal and butane cylinders by ship. The island wishes to make a transition in its production in order to avoid a total blackout if the electricity cable breaks and thus tends towards the development of renewable energy production sources.

4.14.2 Evaluation of electricity consumption

4.14.2.1 Electricity consumption on the island

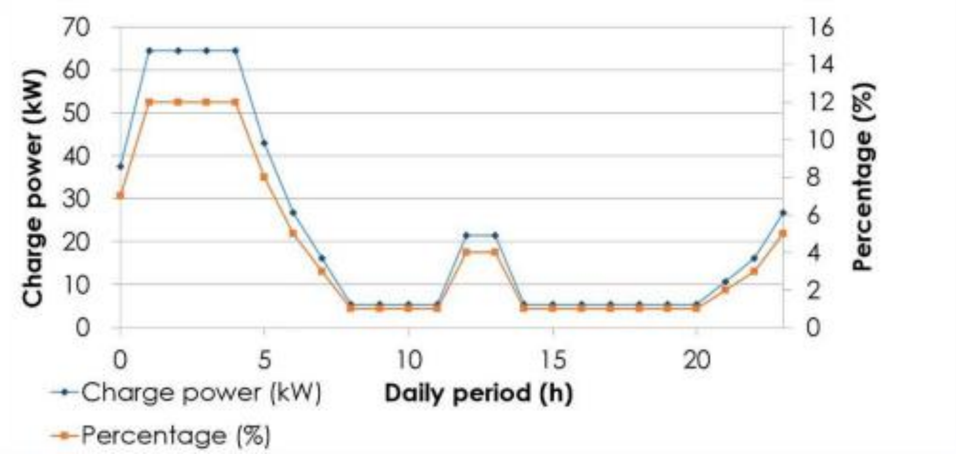


Figure 50 - Consumption on a day

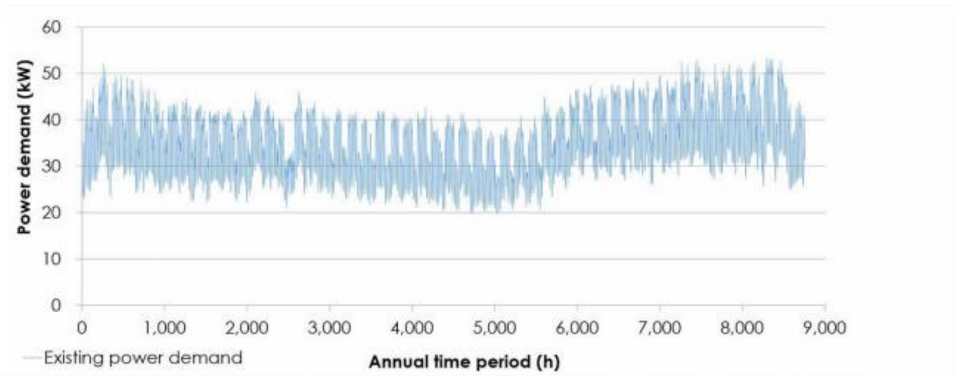


Figure 51 - Consumption on a year

Ile de Cléire's annual consumption is classic in terms of needs: we notice an increase in electricity consumption in winter (from October to March) because the energy needs (heating, lights etc.) are greater during these periods. On the other hand, the summer months are hollow and are characterized by a decrease in energy demand.

4.14.2.2 Consumption by consumer category and geographic area

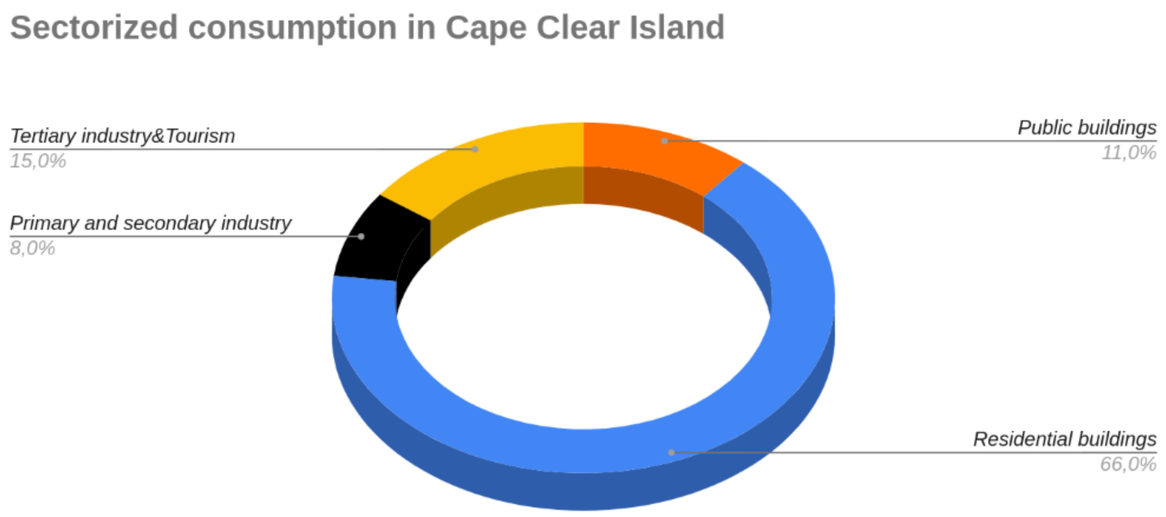


Figure 52 - Sectorized consumption on Cape Clear island

4.14.2.3 Consumption patterns

Most of the island's consumption is used in the tertiary sector and tourism (2/3). The island is sparsely inhabited on average but is very touristy and has many gites and hotels consuming a relatively large share of energy, the energy optimization of these buildings is therefore necessary and is carried out (LED bulbs, building optimization).

This island also has a small fishing and agricultural industry consuming less than 10% of the total electrical energy of the island. Here also at the local level, efforts are made to try to optimize electricity consumption.

4.14.3 Evaluation of electricity production, transport and distribution means

4.14.3.1 Existing system

The following table shows the current power generation system on Cape Clear Island.

Energy source	***Submarine cable***
Producer	ESB
Date of commissioning	1996
Connection power (kW) / Capacity	0,100871005

Table 40 - Existing system Cape Clear Island

The submarine cable linking the island and Ireland brings and supplies all the necessary power to Cape Clear. It is also likely that there are back-up generators in case the cable is under maintenance or breaks down, however, we have not found evidence of such large-scale installations.

MRE project feasibility studies have been completed and a new power generation facility could be developed around the island within the next five years.

4.14.3.2 Evaluation of the market for innovative technologies

As explained in Johan Daelman's preliminary study, characterizing the Marine Renewable Energy (MRE) resource is an expert work generally attributed to research institutes. Having had a brief introduction to the different types of information needed to characterize renewable resources, the objective is now simply to identify the institutes able to provide this kind of data for different renewable resources with a strong interest in MRE. Where some information is provided by the institutes or other documentation, it will be presented to illustrate the summary table.

In addition, the research carried out in the framework of this study has made it possible to access a lot of information related to this part via studies already carried out, websites, scientific articles, etc. The results gathered and deemed relevant will also be presented to give the reader a more precise idea of the renewable energy potential of this NZI.

The following summary table presents the institutes able to provide characterization data of the energy potential for each of the associated resources.

Type of resource	**Institutes able to deliver resource characterization data**
Tidal Energy from Tides	For France (and Europe to some extent), the tide directory of the French Navy's hydrographic and oceanographic service (SHOM) serves as a reference for a wide choice of ports.
Other energy sources (tidal, wave, wind, solar, osmotic and thermal)	Data base ERA-5 and ERA Interim

Table 41 - Presentation of the institutes providing renewable resource data for Cléire

4.14.4 Evaluation of energy transition policies

4.14.4.1 Identification of local actors

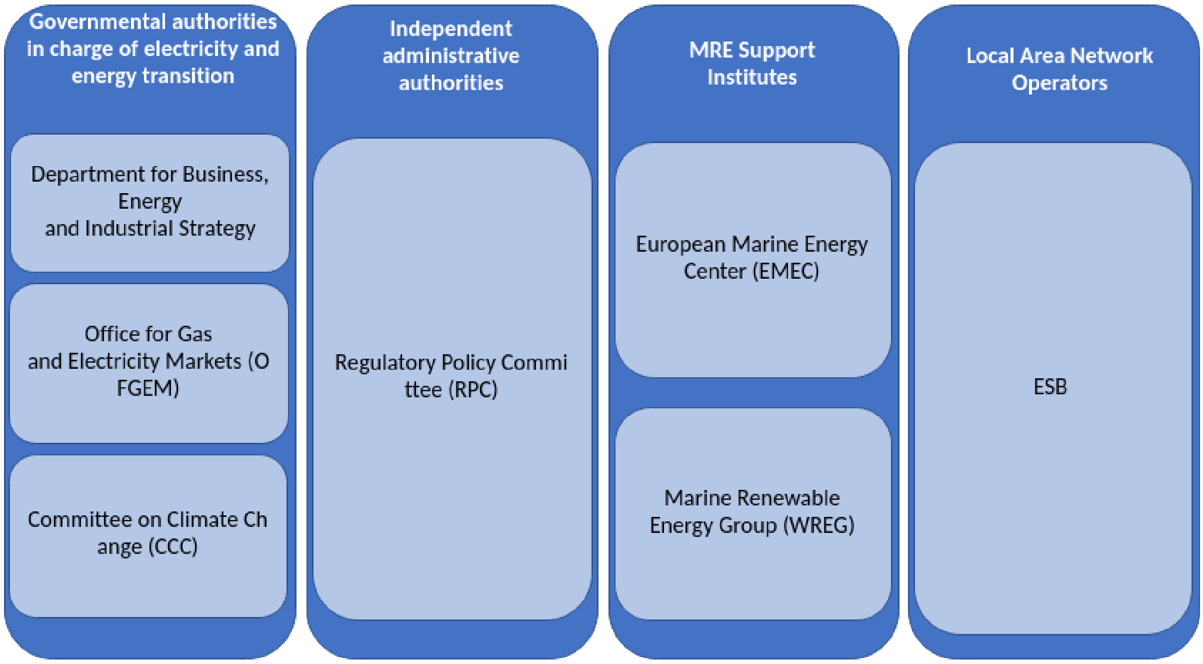


Figure 53 - Local actors of Cape Clear island

4.14.4.2 Identification of existing programmes and current energy transition policies

Cape clear island is resolutely turned towards the typical Smart Island project. Currently connected by electric cable to the mainland since 1996, it wishes to reduce its carbon footprint on its land, caused by the large coal and peat ferry used for fires and cooking plates.

Many residents still use fuel oil and gasoline for their emergency power and vehicles and want this to change.

To this end, a green electricity programme was launched in 1986, consisting of the implementation of wind power systems; this system has not been sustained. The island is now a guinea pig in a global experiment in the use of electric minibuses, which are charged via green industries.

The island wants to expand its project to become an exemplary Smart Island.

4.14.4.3 Assessment of the relevance of ongoing programmes and projects

The general public is very much in favour of this type of programme, which, however, remains minor in their overall vision. The island community would like assistance in planning and support for the development of more ambitious projects.

The current experimental project is working very well and is promising for future experimentation or even full project development.

4.14.5 Contacts

Contacts for electricity supply and power grid management	* Electricity generator: ESB Website: https://www.esb.ie Local number: 1850 372 757 Mail: esbnetworks@esb.ie
Contacts able to support the implementation innovative energy solutions by companies	Island Development Cooperative Comharchumann Chléíre Teoranta Phone: 028 39119 Mail: ccteo@iol.ie
Research institutes and other contacts able to transmit elements to characterize renewable resources	* BODC: https://www.bodc.ac.uk/data/all-data.html * Plateforme de meteoblue : https://www.meteoblue.com/fr/meteo/historyclimate/climatemodelled/ouessant_france_6618260 *The National Wind Speed (NOABL) : http://www.renew-reuse-recycle.com/noabl.pl?n=503 * PVGIS: https://ec.europa.eu/jrc/en/pvgis * Global Solar Atlas: https://globalsolaratlas.info/map * Copernicus Climate Data Store: https://cds.climate.copernicus.eu/cdsapp#!/home

Table 42 - Contacts for Cape Clear

4.15 Heligoland [Germany]

4.15.1 Island's presentation

The island of Helgoland is located 50 kilometres off the coast of Germany in the North Sea. 1149 people live on this small island which explains the very high population density: 740 inhabitants/km2.

Although the island has been connected to Germany by a submarine cable since 2009, it is the longest in the country and one of the longest AC submarine power cables in the world (53 kilometres), which entails substantial maintenance costs. Before being connected to the national electricity grid, electricity on Heligoland was generated by a local diesel power plant. An offshore wind turbine project failed in 1990 for insurance reasons, but the island aims to develop this technology in the future.

4.15.2 Evaluation of electricity consumption

Despite several attempts to contact the local authorities on the island, we have received no response from them. We are therefore not in a position to present consumption data.

4.15.3 Evaluation of electricity production, transport and distribution means

4.15.3.1 Existing system

Electricity has been transmitted to the island via a submarine cable since 2009. This is a 30 kV three-phase cable for the power supply of the island of Helgoland and was manufactured in one piece by Norddeutsche Seekabelwerke for the energy supplier E.ON Hanse. This cable replaces the diesel generators used to produce the island's electricity.

4.15.3.2 Evaluation of the market for innovative technologies

Numerous offshore wind farm projects are under construction in the north and west of the island, which attests to the presence of wind resources off the island. However, the development of these solutions for the use of electricity produced directly by the island is not planned.

As explained in Johan Daelman's preliminary study, characterizing the Marine Renewable Energy (MRE) resource is an expert work generally attributed to research institutes. Having had a brief introduction to the different types of information needed to characterize renewable resources, the objective is now simply to identify the institutes able to provide this kind of data for different renewable resources with a strong interest in MRE. Where some information is provided by the institutes or other documentation, it will be presented to illustrate the summary table.

In addition, the research carried out in the framework of this study has made it possible to access a lot of information related to this part via studies already carried out, websites, scientific articles, etc. The results gathered and deemed relevant will also be presented to give the reader a more precise idea of the renewable energy potential of this NIA.

The following summary table presents the institutes able to deliver energy potential characterization data for each of the associated resources.

Resource Type	Institutes able to deliver resource characterisation data
Tidal Energy from Tides	For France (and Europe to some extent), the tide directory of the French Navy's hydrographic and oceanographic service (SHOM - Service Hydrographique et Océanographique de la Marine) serves as a reference for a wide choice of ports.
Tidal Energy from Currents	The data portals of SHOM and the French Research Institute for Exploitation of the Sea (IFREMER - Institut français de recherche pour l'exploitation de la mer) have data on the intensity of surface and deep currents.
Wave Energy from Waves	IFREMER's MARC model is a good tool for obtaining a directional spectrum of the swell. In addition, CEREMA offers a service for the installation and operation of a wave measuring station.
Osmotic energy	The SHOM and IFREMER data portals are also to be queried first.
The thermal energy of the seas	
Wind energy	The Centre d'études et d'expertise sur les risques, l'environnement, la mobilité et l'aménagement (CEREMA) offers a service for assessing the potential deposits and impacts of marine renewable energies. The meteoblue platform shares local meteorological data for the whole world with a resolution of 30 km. In particular, wind roses are offered. For greater accuracy, they offer high-resolution simulations with hourly data.
Solar energy	The EU Joint Research Centre's solar modelling software, PVGIS, estimates the energy production potential that can be realised by photovoltaic solar technology on the basis of average solar irradiation for a given geographical location. The Global Solar Atlas also provides quick and easy access to data on solar resources around the world.

Table 43 - Instances able to deliver resource characterisation data for Heligoland

4.15.4 Evaluation of energy transition policies

4.15.4.1 Identification of local actors

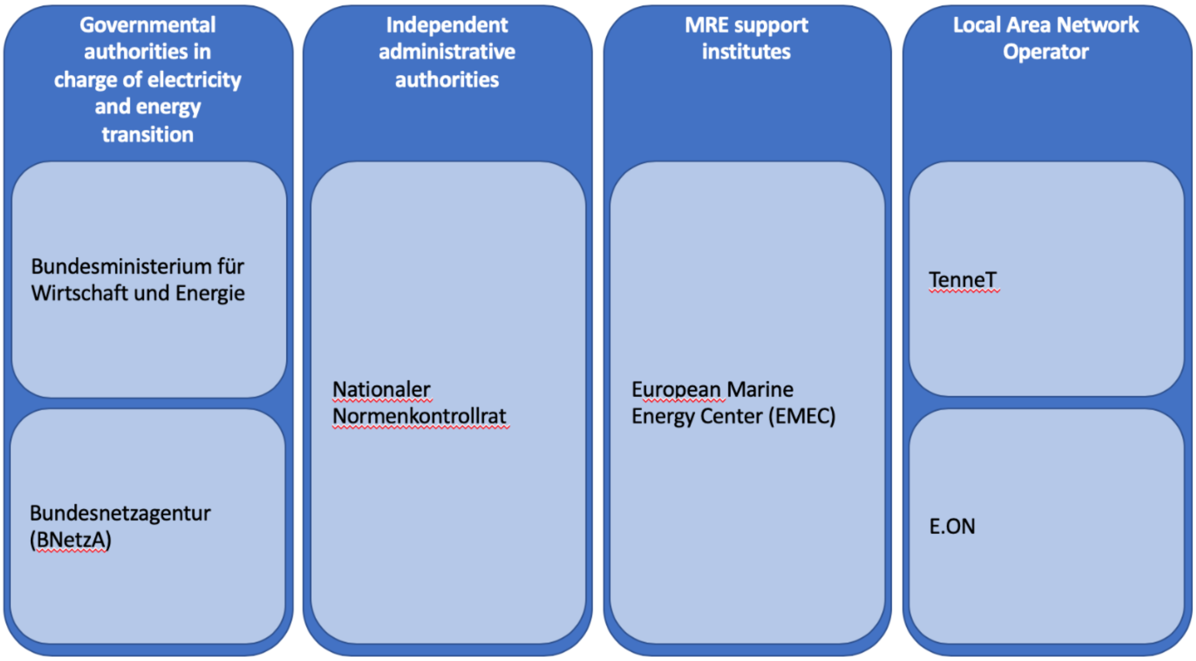


Figure 54 - Local actors of Heligoland

4.15.4.2 Identification of existing programmes and current energy transition policies

The island of Helgoland is ideally located in the northern sea to be used as a base for maintenance operations and development on the many offshore wind farms that are mostly located in the north and west of the island. Over 100 employees have joined the 1,400 inhabitants of the island.

A part for the wind farms off the coast of the island, no new project is being developed for the electricity of the island.

4.15.4.3 Assessment of the relevance of ongoing programmes and projects

The abundance of wind farms of the coast of the island in a god indicator of the potential market for MRE. However, no project of developing MRE specifically for the island exist as of right now.

4.15.5 Contacts

Local authorities	* Commune de Heligoland Phone: +49 (0) 4725/808-0 Web site: https://www.helgoland.de/rathaus/ (contact via le site)

Table 44 - Contacts for Heligoland

4.16 Island of Ventotene [Italy]

4.16.1 Island's presentation

The island of Ventotene, an island municipality attached to the province of Latina in Italy, is in the Tyrrhenian Sea, off the coast of Naples and 50 kilometres from the mainland. This Italian island has a population of 754 inhabitants and a population density of 490 inhabitants/km² and welcomes many tourists every year.

Not connected to the mainland by a submarine cable, the island of Ventotene is completely electrically insulated. Its energy production is based on its four diesel generators, each with a nominal capacity of 480 kW. In addition, there is a willingness on the part of the island to develop renewable energy sources on its territory in order to decarbonise its electricity production and diversify its energy mix. Indeed, the island of Ventotene has already begun its intelligent energy transition by deploying an increasing number of photovoltaic panels on the roofs of buildings. Supported by Europe, the island has also installed a 300kW/600kWh lithium-ion battery storage system project to help integrate solar power generation on the island.

4.16.2 Evaluation of electricity consumption

4.16.2.1 Electricity consumption on the island

Data on the island's electricity consumption, whether on an annual, monthly or daily basis, could not be obtained despite efforts to find them. In fact, many websites were visited and searched in depth in order to find these data. It seems that they are simply not freely available. Nevertheless, several local contacts have been contacted. First of all, the local authorities of the island of Ventotene as well as associations working on projects on the island directed us to the manager of the electrical network which is Enel. Enel has been contacted via 3 different addresses but we have had no response to date. It seems that a PEC e-mail address is required to send e-mails to certain Italian authorities, but this type of e-mail address is subject to a charge. The following table lists the authorities contacted for the island of Ventotene:

Instances contacted	Email addresses
Legambiente association	legambiente@legambiente.it
Ventotene Town Planning, Construction and Land Development	tecnico@comune.ventotene.lt.it
Town Hall Secretary	segretario@comune.ventotene.lt.it
Island Secretariat	segreteria@comune.ventotene.lt.it
State Nature Reserve and Marine Protected Area	info@riservaventotene.it
State Nature Reserve and Marine Protected Area	direzione@riservaventotene.it
Mayor	sindaco@comune.ventotene.lt.it

Enel	eneldistribuzione@pec.enel.it
Enel	lam_portaleproduttori@enel.com
Enel	ufficiostampa@enel.com
Smart island project	info@smartisland.eu
Project for small Italian islands	info@isolesostenibili.it

Table 45 - Instances contacted for access to Ventotene Island power consumption data

4.16.2.2 Consumption patterns

This section aims to present the consumption pattern of Ventotene Island. Firstly, about the least energy efficient activities, the findings are the same as in most of the NIAs studied in this report. Indeed, energy-intensive activities always concern the same areas, whether it is the renovation of old buildings for better energy efficiency (insulation, double glazing, etc.), lighting with the use of LED bulbs or the replacement of energy-intensive appliances such as refrigerators.

At Ventotene, the energy transition programmes are based on national and European directives, which have identified certain energy-intensive activities and provide funding for new solutions. For example, the "Energy and Territorial Development 2014-2020" programme of the Italian Ministry of Economic Development has earmarked a total financial allocation of 120.4 million euros for islands in the least developed regions. 120.4 million for islands in less developed regions. The programme provides funding for actions to improve the energy efficiency of existing installations. The programme is intended to develop the promotion of eco-efficiency and the reduction of primary energy consumption in public buildings and structures. This involves the renovation of individual buildings or local complexes, the installation of intelligent remote-control systems, the regulation, management, monitoring and optimisation of energy consumption (intelligent buildings) and pollutant emissions. Ventotene Island is one of the main beneficiaries of these support programmes.

Moreover, with more than 50,000 tourists per year for a population of 769 inhabitants, Ventotene Island also has to cope with impressive consumption peaks during the summer period.

4.16.3 Evaluation of electricity production, transport and distribution means

4.16.3.1 Existing system

The following table shows the overall electricity generation system on Ventotene Island.

	4 diesel generators	**Photovoltaic panels**	**Storage systems**
Sector / power supply	Diesel	Solar	Lithium-ion batteries

Producer	Enel Produzione	-	Enel Produzione
Date of commissioning	-	Gradually since the 2000s	2015
Connecting power / Capacity	1920 kVA (480 kVA each)	98.1 kW in total (in 2019)	300kW/600kWh

Table 46 - Existing system on Ventotene Island

According to a study by the "Sustainable islands observatory on smaller Italian islands", entitled "ENERGY, WATER, MOBILITY, CIRCULAR ECONOMY, SUSTAINABLE TOURISM. The challenges for the smaller islands and best practices from all over the world" and published in 2020 with the support of the environmental association Legambiente and CNR-IIA, it appears that the electricity produced on the island of Ventotene is mainly based on generators with a production of 2,700 MWh per year. Regarding renewable resources, only solar energy is exploited with several photovoltaic panels and there is also the consideration of thermal solar energy with an installed surface in 2019 of 6.29 m². However, in 2019, there were no wind turbines on the island.

In addition, it is worth mentioning the Enel plan to be implemented on the island to have zero CO2 emissions. The plan foresees the installation of centralized or distributed photovoltaic systems and the installation of mini wind turbines to produce electricity without CO2 emissions. Enel, in particular, wants to experiment with innovative photovoltaic panels consisting of a layer of photosensitive pigment, anthocyanin, obtained from blueberries. These mixed organic panels therefore use no silicon and cost less than half as much as traditional panels, even though they deteriorate earlier and give a slightly lower energy yield.

In addition, in collaboration with the Una Foundation, a fleet of electric minibuses for tourist services aimed at reducing the consumption of fossil fuels has been created. This initiative is part of a broader framework of initiatives for environmental sustainability promoted by the Lazio region since 2010 on the island. In particular, with the pilot project entitled "Ventotene, Zero Emission Island", a series of activities aimed at introducing technologies for renewable energy production and sustainable mobility have taken place.

4.16.3.2 Evaluation of the market for innovative technologies

As explained in Johan Daelman's preliminary study, characterizing the Marine Renewable Energy (MRE) resource is an expert work generally attributed to research institutes. Having had a brief introduction to the different types of information needed to characterize renewable resources, the objective is now simply to identify the institutes able to provide this kind of data for different renewable resources with a strong interest in MRE. Where some information is provided by the institutes or other documentation, it will be presented to illustrate the summary table.

In addition, the research carried out in the framework of this study has made it possible to access a lot of information related to this part via studies already carried out, websites, scientific articles, etc. The results gathered and deemed relevant will also be presented to give the reader a more precise idea of the renewable energy potential of this NIA. The figures from the different institutes will be presented in the appendix for a better readability of the report.

The following summary table presents the institutes able to provide energy potential characterisation data for each of the associated resources for Ventotene Island.

Type of resource	Institutes able to deliver resource characterization data
Tidal energy from tides	CNR-ISMAR (Consiglio Nazionale delle Ricerche - Istituto di Scienze Marine) has an articulated network for real-time data collection in the Italian seas.
Tidal energy from currents	
Wave energy from waves	
Osmotic energy	
Thermal energy from sea water	
Wind energy	The meteoblue platform shares local weather data for the whole world with a resolution of 30 km. Among other things, wind roses are offered. For greater accuracy, they offer high-resolution simulations with data for every hour.
Solar energy	The EU Joint Research Centre's solar modelling software, PVGIS, estimates the energy production potential that can be realised by photovoltaic solar technology on the basis of average solar irradiation for a given geographical location. The Global Solar Atlas also provides quick and easy access to data on solar resources around the world.

Table 47 - Presentation of the institutes providing renewable resource data for Ventotene island

4.16.4 Evaluation of energy transition policies

4.16.4.1 Identification of local actors

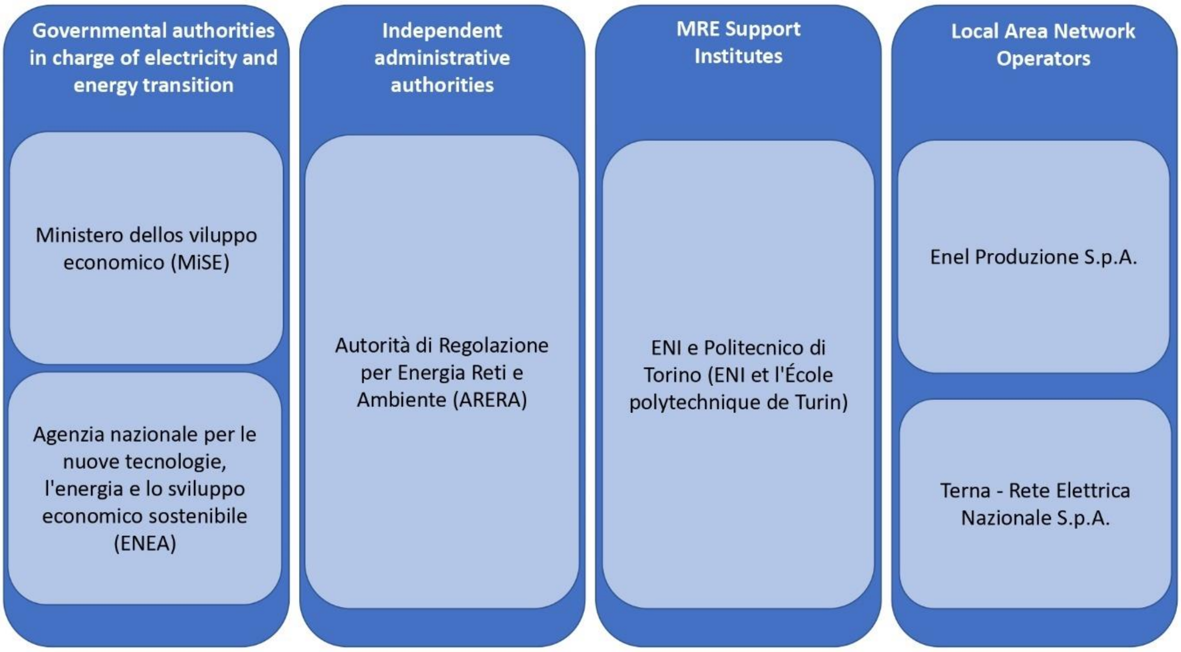


Figure 55 - Local actors of Ventotene

4.16.4.2 Identification of existing programmes and current energy transition policies

Ventotene Island has undertaken some energy transition measures to limit the consumption of fossil fuels used by the four diesel generators, which are also used to meet seasonal variations in electricity demand caused by the annual influx of tourists.

The island is gradually turning to renewable energy sources, in particular solar energy, which is abundant in this Italian region. Indeed, the installation of solar panels on roofs is becoming increasingly popular on the island even though in 2018 it represented only 3.5% of the island's electricity needs with an installed capacity of 47 kW.

In addition, Ventotene's key innovation is its lithium-ion battery energy storage unit, which will be operational in 2015. The main objective of this project is to improve the flexibility of grid operation and to optimize the use of the power of the existing diesel engines, thus increasing the sustainability of the island. This ensures that diesel generators can be used in a more efficient mode of operation as peak loads are covered by the energy from the storage system and not from the generators. In off-peak periods, it is even possible to shut down the diesel generators completely. This results in a 15% reduction in fuel consumption, which has to be transported to the island from the mainland, and therefore a reduction in CO2 emissions. As a result, this prolongs the life of the diesel generators, minimises their maintenance and reduces the stock of fuel reserves. The investment was financially supported by the European Investment Bank. It also paved the way for the installation of additional photovoltaic systems without causing grid imbalance.

The island has also put in place preparatory work for future intelligent applications, such as charging stations for electric vehicles. In addition, Enel S.p.A. has also initiated steps for a pilot project on the island with the aim of making it self-sufficient through renewable sources. The plan foresees the development of wind turbines, thermal and photovoltaic solar panels, energy storage with hydrogen, the use of biomass and biodiesel.

In addition, Ventotene's energy transition approach is supported by the Italian government. Indeed, on 14 February 2017, the Ministry of Economic Development (MiSE) published a decree in which it sets out its willingness to act for the "gradual coverage of the needs of small islands that are not interconnected by energy from renewable sources". For example, it refers to the objectives of ensuring the progressive coverage of energy needs from renewable sources and promoting energy efficiency.

In order to give effect to this decree, quantitative and temporal objectives and the means to support the investments needed to achieve them have been developed. On the island of Ventotene, the objectives for the end of 2020 are to reach a target power for renewable energies of 170 kW and a target solar thermal area of 200 m². In addition, these measures extend to 2030 with further decrees to be issued later, which will update the objectives according to the actions undertaken and the evolution of the situation.

4.16.4.3 Assessment of the relevance of ongoing programmes and projects

As a result, the energy transition approaches launched for Ventotene Island are relatively recent and there is real market potential for several technologies. The island's energy mix is only at its beginning and the Italian authorities are open to various foreign partners, as shown by their collaboration with Fluence Energy, an American company created in 2018 which allowed the installation of the storage system on the island. The Italian State also supports all innovative approaches to make these non-interconnected islands energy self-sufficient.

4.16.5 Contacts

Contacts for electricity supply and power grid management	*** ENEL PRODUZIONE SPA** (utility responsible for operating the diesel generation and the distribution network) Website: https://www.enel.it/it/contattaci Phone number: +39-0683051
Competent local authorities	*** Municipality of Ventotene** Phone number: 0771/85014 Email PEC: protocol@pec.comune.ventotene.lt.it Website: https://www.halleyweb.com/c059033/hh/index.php
Contacts able to support the implementation innovative energy solutions by companies	*** Legambiente association** Email: legambiente@legambiente.it Website: https://www.legambiente.it/contattaci/ *** Fluence Energy company** (storage system installer)

	Website: https://fluenceenergy.com/contact/ Phone number: +49 9131 9289400 ***Smart island and isolesostenibili projects** Mail: info@smartisland.eu francescopetracchini@gmail.com info@isolesostenibili.it
Research institutes and other contacts able to transmit elements to characterise renewable resources	*** CNR-ISMAR:** http://www.ismar.cnr.it/prodotti/condivisione-dati *** Plateform of meteoblue :** https://www.meteoblue.com/fr/meteo/historyclimate/climatemodelled *** PVGIS:** https://ec.europa.eu/jrc/en/pvgis *** Global Solar Atlas:** https://globalsolaratlas.info/map

Table 48 - Contacts for Ventotene

4.17 Island of Salina [Italy]

4.17.1 Island's presentation

The island of Salina, part of the Aeolian Islands, is in the Mediterranean Sea, 40 kilometres off the coast of Italy, north of Sicily. The island is home to 2598 people, particularly in its three towns of Santa Marina, Malfa and Leni, with a population density of 100 inhabitants/km2.

This island, classified as a UNESCO World Heritage Site, is electrically isolated from Italy. Italy consumes almost 1800 tons of diesel every year to supply itself with electricity, which represents about 70% of its energy consumption. Salina's carbon emissions amount to nearly 6,000 tons of CO_2 per year. In addition, the island has entered its energy transition and aims to develop its energy mix thanks to its abundant renewable resources, particularly in terms of electricity and heat.

4.17.2 Evaluation of electricity consumption

4.17.2.1 Electricity consumption on the island

Total electricity consumption is 8160 MWh per year. Below is the table from a report produced as part of the Clean Energy for EU Islands in 2020 project, from which these data are taken:

Energy Consumption Category		Residential and public buildings	Primary and secondary sector (agriculture, fishing, service supply, industry)	Tertiary sector (including tourism)	Transportation on island	Final or primary energy consumption on island	Transportation from and to the island	Final or primary energy total consumption
Electricity (MWh)	Final	4,067	730	3,363		8,160		8,160
	Primary	13,119	2,355	10,848		26,322		26,322
Fossil fuels primary energy (MWh)	LPG	1,286		904		2,190		2,190
	Diesel oil		1,284		6,327	7,611	61,028	68,639
	Gasoline				6,827	6,827		6,827
Thermal solar panels substituting electricity (MWh)	Final thermal	9				9		9
	Primary	29				29		29
Total primary energy (MWh)		**14,434**	**3,639**	**11,752**	**13,154**	**42,979**	**61,028**	**104,007**

Figure 56 - Consumption data for Salina in 2020

Le résidentiel et le secteur tertiaire, dont le tourisme, constituent la principale consommation électrique de Salina comme le montre le graphe suivant.

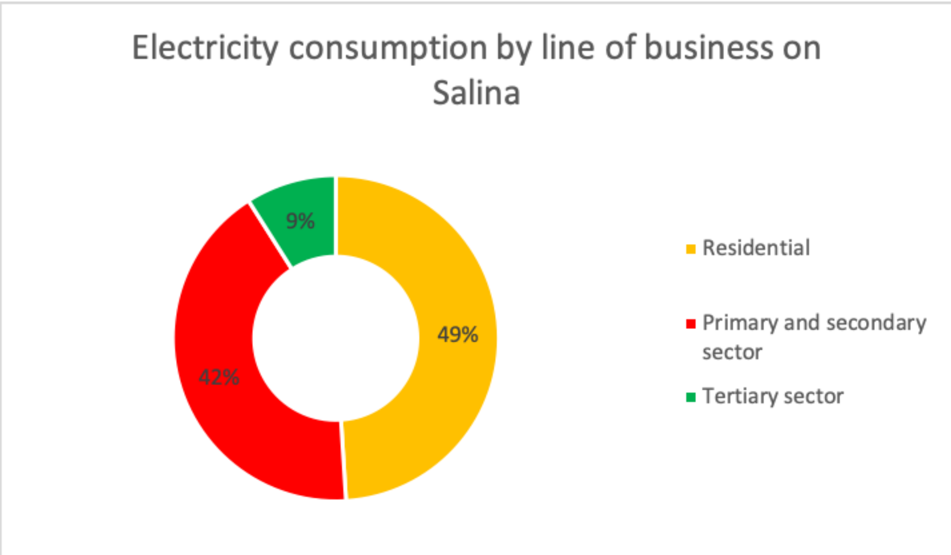


Figure 57 - Demand for electricity on Salina

4.17.3 Evaluation of electricity production, transport and distribution means

4.17.3.1 Existing system

Currently, Salina is dependent on diesel generators for its electricity. As an indication, Salina emits more than 6,000 tonnes of CO_2 each year due to the use of diesel and gas.

4.17.3.2 Evaluation of the market for innovative technologies

The Clean Energy for EU Islands report is very comprehensive on the MRE issue. The following is a summary of the study's conclusion. For more information, please refer to the study.

The coast of Salina is not very suitable for MRE or wind energy. The low wave potential combined with the high cost of wave technology does not create favourable conditions for the development of this market on the island. The report explicitly states that this does not seem economically feasible. Similarly, for tidal turbine technology, the report considers that the currents are too weak and that there is not enough bottom for this type of installation. The report concludes that the implementation of renewable energy resources in general on the island seems to be a very complicated task.

As explained in Johan Daelman's preliminary study, characterizing the Marine Renewable Energy (MRE) resource is an expert work generally attributed to research institutes. Having had a brief introduction to the different types of information needed to characterize renewable resources, the objective is now simply to identify the institutes able to provide this kind of data for different renewable resources with a strong interest in MRE. Where some information is provided by the institutes or other documentation, it will be presented to illustrate the summary table.

In addition, the research carried out in the framework of this study has made it possible to access a lot of information related to this part via studies already carried out, websites, scientific articles, etc. The results gathered and deemed relevant will also be presented to give the reader a more precise idea of the renewable energy potential of this NIA. The figures from the different institutes will be presented in the appendix for a better readability of the report.

The following summary table presents the institutes able to provide energy potential characterisation data for each of the associated resources for Salina Island.

<table>
<tr><th>Type of resource</th><th>Institutes able to deliver resource characterization data</th></tr>
<tr><td>Tidal Energy from Tides</td><td rowspan="5">CNR-ISMAR (Consiglio Nazionale delle Ricerche - Istituto di Scienze Marine) has an articulated network for real-time data collection in the Italian seas.</td></tr>
<tr><td>Tidal Energy from Currents</td></tr>
<tr><td>Wave Energy from Waves</td></tr>
<tr><td>Osmotic energy</td></tr>
<tr><td>Thermal energy from sea water</td></tr>
<tr><td>Wind energy</td><td>The meteoblue platform shares local weather data for the whole world with a resolution of 30 km. Among other things, wind roses are offered. For greater accuracy, they offer high-resolution simulations with data for every hour.</td></tr>
</table>

Solar energy	The EU Joint Research Centre's solar modelling software, PVGIS, estimates the energy production potential that can be realised by photovoltaic solar technology on the basis of average solar irradiation for a given geographical location. The Global Solar Atlas also provides quick and easy access to data on solar resources around the world.

Figure 58 - Instances able to deliver resource characterisation data for Salina

4.17.4 Evaluation of energy transition policies

4.17.4.1 Identification of local actors

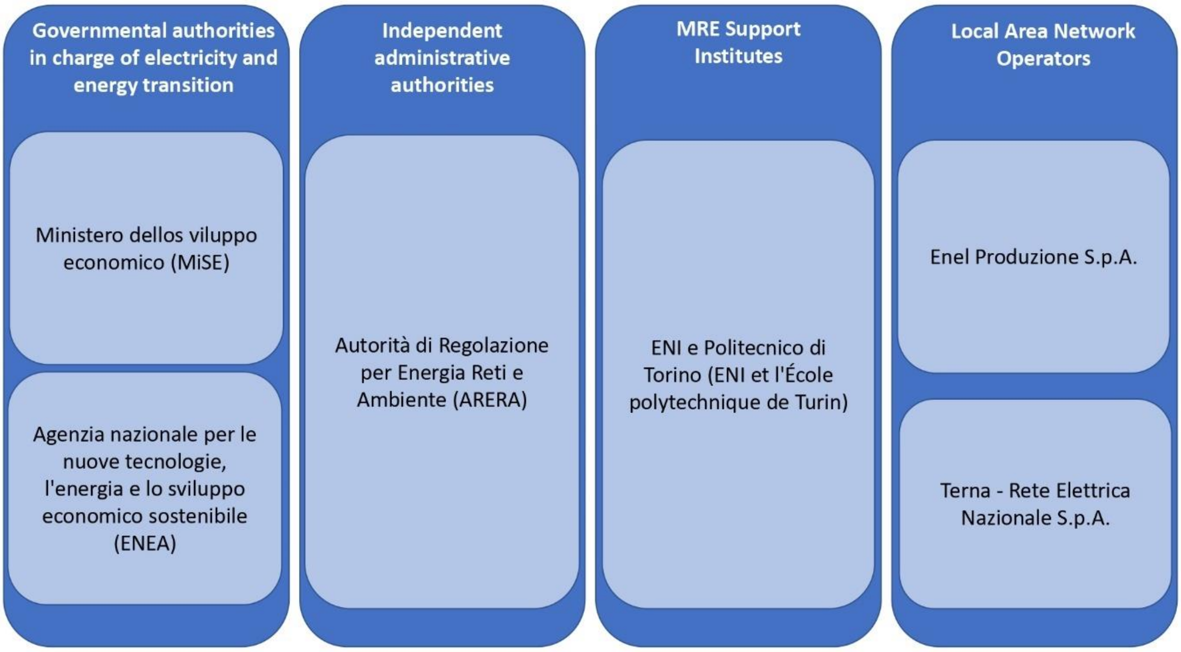


Figure 59 - Local actors of Salina

4.17.4.2 Identification of existing programmes and current energy transition policies

Project ERIC and Marevivo are 2 project that aim at informing the people of the island about the importance of renewable energy, environmental protection, reduction of air pollution…

Some hotels and local wine makers have looked into the economic impact of investing in bio-digestors to turn their wastes biogas.

Local authorities have promoted the use of electric cars by placing charging stations on the island.

The program that is at the heart of all these different projects is the Clean Energy for EU Islands program. This program was born in 2017 when the EU commission, together with 14 member states, signed the Political Declaration on Clean Energy for EU Islands. This initiative helps and finances projects that are involve in clean energy generation, housing energy efficiency, heating and cooling and transportation to and from the islands as well as on the islands.

4.17.4.3 Assessment of the relevance of ongoing programmes and projects

The Clean Energy for EU Island program is a real opportunity for ICE because of the European collaboration and the collaboration with many EU islands.

4.17.5 Contacts

Local authorities	*** Commune de Santa Marina** Mail : postmaster@pec.comune.santa-marina-salina.me.it Mail de l'office technique : tecnicosalina@pec.it Web site: http://www.comune.santa-marina-salina.me.it *** Commune de Malfa** Phone: 0909844008/300/326 Mail : comunemalfa@pec.it Web site: http://www.comune.malfa.me.it *** Commune de Leni** Phone: 090/9809125 Mail : info@comune.leni.me.it Web site: http://www.comune.leni.me.it
Research institutes and other contacts able to transmit elements to characterize renewable resources	*** CNR-ISMAR:** http://www.ismar.cnr.it/prodotti/condivisione-dati *** Meteoblue platform :** https://www.meteoblue.com/fr/meteo/historyclimate/climatemodelled *** PVGIS:** https://ec.europa.eu/jrc/en/pvgis *** Global Solar Atlas:** https://globalsolaratlas.info/map

`

Table 49 - Contacts for Salina

4.18 Island of Kythnos[Greece]

4.18.1 Island's presentation

The island of Kythnos, a small Greek island in the Cyclades, is located 40 kilometres from the mainland. Its population is 1456 inhabitants for a density of 15 inhabitants/km2.

The island is electrically isolated from the mainland and neighbouring islands. It currently produces its electricity from thermal generators. The island also has a range of renewable energy technologies such as a solar power plant coupled with batteries and a hybrid wind turbine, battery storage and an automatic control system but these are currently obsolete. Only the solar installations are in operation today. The current installed generation capacity on the island is 4.97 MW with a peak consumption of 2.7 MW.

The island has been oriented towards renewable energies for many years: it was the first wind turbine site in Europe in 1982. Today it aims to develop renewable energies and has received European aid (52 million euros) for this purpose.

4.18.2 Evaluation of electricity consumption

After multiple attempts to contact the island's local authorities, we did not receive any response. We are not able to present consumption data for this island.

4.18.3 Evaluation of electricity production, transport and distribution means

4.18.3.1 Existing system

Electricity is mainly produced by diesel generators with a total capacity of 4.97 MW.

4.18.3.2 Evaluation of the market for innovative technologies

The island of Kythnos is famous for having hosted the first wind farm in Europe. Indeed, the wind is favourable for the implantation of this type of installation. From an MRE point of view, currents and waves are of little interest to develop a lucrative, or even viable market.

As explained in Johan Daelman's preliminary study, characterizing the Marine Renewable Energy (MRE) resource is an expert work generally attributed to research institutes. Having had a brief introduction to the different types of information needed to characterize renewable resources, the objective is now simply to identify the institutes able to provide this kind of data for different renewable resources with a strong interest in MRE. Where some information is provided by the institutes or other documentation, it will be presented to illustrate the summary table.

In addition, the research carried out in the framework of this study has made it possible to access a lot of information related to this part via studies already carried out, websites, scientific articles, etc. The results gathered and deemed relevant will also be presented to give the reader a more precise idea of the renewable energy potential of this NIA. The figures from the different institutes will be presented in the appendix for a better readability of the report.

The following summary table presents the institutes able to provide energy potential characterisation data for each of the associated resources for Kythnos Island.

Type of resource	Institutes able to deliver resource characterization data
Wind energy	The meteoblue platform shares local weather data for the whole world with a resolution of 30 km. Among other things, wind roses are offered. For greater accuracy, they offer high-resolution simulations with data for every hour.
Solar energy	The EU Joint Research Centre's solar modelling software, PVGIS, estimates the energy production potential that can be realised by photovoltaic solar technology on the basis of average solar irradiation for a given geographical location. The Global Solar Atlas also provides quick and easy access to data on solar resources around the world.

Table 50 - Instances able to deliver resource characterisation data for Kythnos

4.18.4 Evaluation of energy transition policies

4.18.4.1 Identification of local actors

Figure 60 - Local actors of Kythnos

4.18.4.2 Identification of existing programmes and current energy transition policies

Kythnos has a long history of green energy project with the first EU wind farm built in 1983. Since then, many projects have been implemented but the island is still dependant on diesel for its electricity.

The EU project WiseGRID aims at developing renewable energy solution in Europe. It is involved in Belgium, Italy and on the island of Kythnos. This project is financed by the EU as part of the Horizon 2020 program.

In 2019, the company VARTA installed 5 batteries to stabilize the electrical network of the island.

4.18.4.3 Assessment of the relevance of ongoing programmes and projects

The WiesGRID project is very implicated on Kythnos and its objectives are coherent with the ICE project: to develop micro-grid services on isolated islands.

4.18.5 Contacts

Local authorities	* Île de Kythnos Mail : info@kythnos.gr Phone: 22813-61100 Web site: https://www.kythnos.gr
Research institutes and other contacts able to transmit elements to characterize renewable resources	*** Plateforme de meteoblue :** https://www.meteoblue.com/fr/meteo/historyclimate/climatemodelled *** PVGIS:** https://ec.europa.eu/jrc/en/pvgis *** Global Solar Atlas:** https://globalsolaratlas.info/map

Table 51 - Contacts for Kythnos

4.19 Island of Tilos [Greece]

4.19.1 Island's presentation

The island of Tilos, a small Greek island in the Dodecanese, is located 25 kilometres off the west coast of Turkey. It has a population of 500 inhabitants with a density of 8 inhabitants/km2.

The island is not connected to the mainland but is linked, thanks to an unreliable underwater electricity interconnection, to the neighbouring island of Kos where there is a diesel generator. However, the island experiences numerous power cuts due to damage to the underwater cable.

The energy transition and the development of renewable energies are therefore real challenges for this island and several projects are under study. For example, the energy transition on this island is being carried out as part of the TILOS project using a prototype battery system based on FIAMM NaNiCl2 batteries.

4.19.2 Evaluation of electricity consumption

After multiple attempts to contact the island's local authorities, we did not receive any response. We are not able to present consumption data for this island.

4.19.3 Evaluation of electricity production, transport and distribution means

4.19.3.1 Existing system

Electricity reaches Tilos via an underwater cable that connects it to the nearby island of Kos where diesel generators are located. The cable is known for its very low reliability and regularly breaks down for sometimes long periods.

	Battery storage	**Wind turbine**	**Solar array (project)**	**Backup diesel generator (project)**
Branch / Energy source	Storage	Wind	Solar	Diesel
Description	System to store renewable electricity production	1 wind turbine E-53-1	592 solar arrays	Diesel generator used if the renewable generation is to low
Site	North-West of the island	North-West of the island	Centre of the island	Centre of the island
Date of commissioning	2019	2019	Project	Project

Capacity	2432 Ah	800 kW	160 kW	1450 kW

Table 52 - Existing system on Tilos

4.19.3.2 Evaluation of the market for innovative technologies

The sunshine as well as the wind makes Tilos a place for solar and wind power. However, there are too few waves or currents around the island to implement MRE solutions.

As explained in Johan Daelman's preliminary study, characterizing the Marine Renewable Energy (MRE) resource is an expert work generally attributed to research institutes. Having had a brief introduction to the different types of information needed to characterize renewable resources, the objective is now simply to identify the institutes able to provide this kind of data for different renewable resources with a strong interest in MRE. Where some information is provided by the institutes or other documentation, it will be presented to illustrate the summary table.

In addition, the research carried out in the framework of this study has made it possible to access a lot of information related to this part via studies already carried out, websites, scientific articles, etc. The results gathered and deemed relevant will also be presented to give the reader a more precise idea of the renewable energy potential of this NIA. The figures from the different institutes will be presented in the appendix for a better readability of the report.

The following summary table presents the institutes able to provide energy potential characterisation data for each of the associated resources for Tilos Island.

Type of resource	Institutes able to deliver resource characterization data
Wind energy	The meteoblue platform shares local weather data for the whole world with a resolution of 30 km. Among other things, wind roses are offered. For greater accuracy, they offer high-resolution simulations with data for every hour.
Solar energy	The EU Joint Research Centre's solar modelling software, PVGIS, estimates the energy production potential that can be realised by photovoltaic solar technology on the basis of average solar irradiation for a given geographical location. The Global Solar Atlas also provides quick and easy access to data on solar resources around the world.

Table 53 - Instances able to deliver resource characterization data for Tilos

4.19.4 Evaluation of energy transition policies

4.19.4.1 Identification of local actors

Figure 61 - Local actors of Tilos

4.19.4.2 Identification of existing programmes and current energy transition policies

The TILOS project is a European project lead by 13 companies and institutes of 7 EU countries. The goal of the project is to showcase the potential of electricity storage using batteries on micro-grids. The project also develops renewable energy production methods using hybrids wind-sun systems and smart grids. The project is financed by the Horizon 2020 EU program.

4.19.4.3 Assessment of the relevance of ongoing programmes and projects

The TILOS program is an opportunity for the companies working with ICE for the European collaboration and the goals of the program. The financial help by the Horizon 2020 program is also non negligible. Also, the willingness of the island to develop green energy sources is proven.

4.19.5 Contacts

Contacts for electricity supply and power grid management	* Production et distribution de l'électricité : Public Power Corporation Web site: http://www.dei.gr/el Mail : info@dei.com.gr Phone: 210 52930301

Local authorities	* Commune de Tilos Mail : info@tilos.gr Phone: +302246360500 Web site: https://www.tilos.gr/fr/

Table 54 - Contacts for Tilos

4.20 Porto Santo, Archipelago of Madeira [Portugal]

4.20.1 Island's presentation

Porto Santo is an island in the Madeira archipelago, known worldwide for its tourist purposes. It is located 50 kilometres from Madeira Island and almost 700 kilometres from Morocco. It is inhabited by 5483 people and has a density of 130 inhabitants/km². It is totally isolated from the mainland electrically with no submarine cable and produces 85% of its electricity from oil generators, four thermal generators and 2MW from solar panels.

However, the island has a real willingness to turn to green electricity and is already beginning its photovoltaic transition and the development of its electric car network.

4.20.2 Evaluation of electricity consumption

4.20.2.1 Electricity consumption on the island

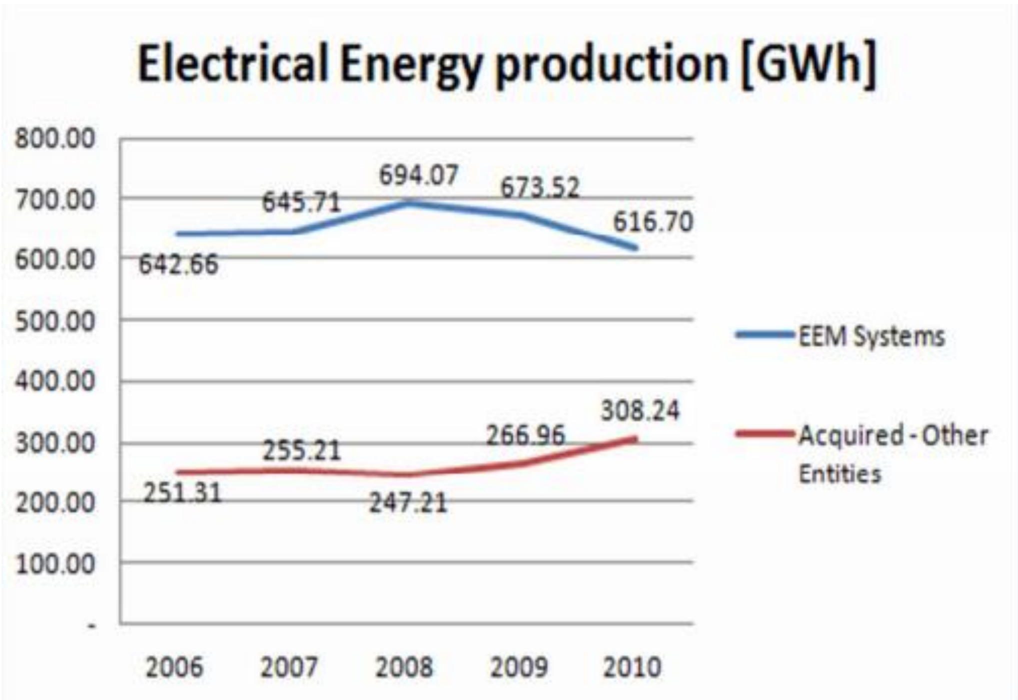


Figure 62 - Annual consumption on Madeira 2006/2010 (EEM,2010)

Annual consumption in Madeira varies little from year to year, with values between 600GWh and 700GWh.

4.20.2.2 Consumption by consumer category and geographic area

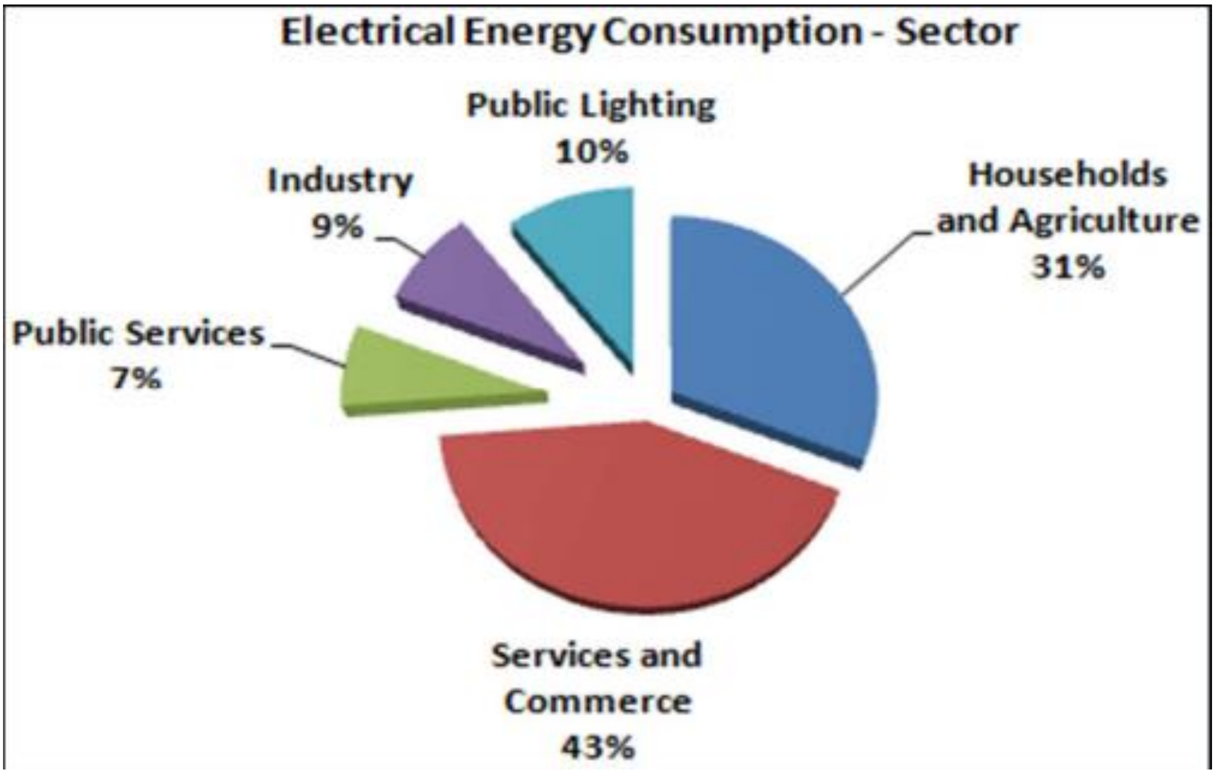


Figure 63 - Consumption on Madeira per sector

4.20.2.3 Consumption patterns

Here we will present the consumption pattern of the Madeira Islands. For years Madeira has been using its exceptional geothermal energy to produce both electricity and heating. In addition to this resource, Madeira has been able to take advantage of all the climatic opportunities it enjoys producing its electricity: wind, solar, use of waste...

4.20.3 Evaluation of electricity production, transport and distribution means

4.20.3.1 Existing system

The following table shows the current system of electricity production in the Madeira archipelago.

	Solar panel fields	*Hydroelectric*	*Thermoelectric*	*ETRSU*	*Eolienne*
Energy source	Sun	Waves/currents	Geotherm	Waste	Wind
Site			Caniçal	Meia Serra	
Connection power (kW) / Capacity (2010)	188	571	22243	4499	7686

Table 55 - System of electricity production in the Madeira archipelago

4.20.3.2 Evaluation of the market for innovative technologies

As explained in Johan Daelman's preliminary study, characterizing the Marine Renewable Energy (MRE) resource is an expert work generally attributed to research institutes. Having had a brief introduction to the different types of information needed to characterize renewable resources, the objective is now simply to identify the institutes able to provide this kind of data for different renewable resources with a strong interest in MRE. Where some information is provided by the institutes or other documentation, it will be presented to illustrate the summary table.

In addition, the research carried out in the framework of this study has made it possible to access a lot of information related to this part via studies already carried out, websites, scientific articles, etc. The results gathered and deemed relevant will also be presented to give the reader a more precise idea of the renewable energy potential of this NZI.

The following summary table presents the institutes able to provide characterization data of the energy potential for each of the associated resources.

Type of resource	**Institutes able to deliver resource characterization data**
Tidal Energy from Tides	For France (and Europe to some extent), the tide directory of the French Navy's hydrographic and oceanographic service (SHOM) serves as a reference for a wide choice of ports.
Tidal Energy from Currents	Ocean Weather Provide currents and waves trend around the world
Wave Energy from Waves	Ocean Weather Provide currents and waves trend around the world

Wind energy	https://globalwindatlas.info The meteoblue platform shares local weather data for the whole world with a resolution of 30 km. Among other things, wind roses are offered. For greater accuracy, they offer high-resolution simulations with data for every hour.

Table 56 - Instances able to deliver resource characterization data for Porto Santo

4.20.4 Evaluation of energy transition policies

4.20.4.1 Identification of local actors

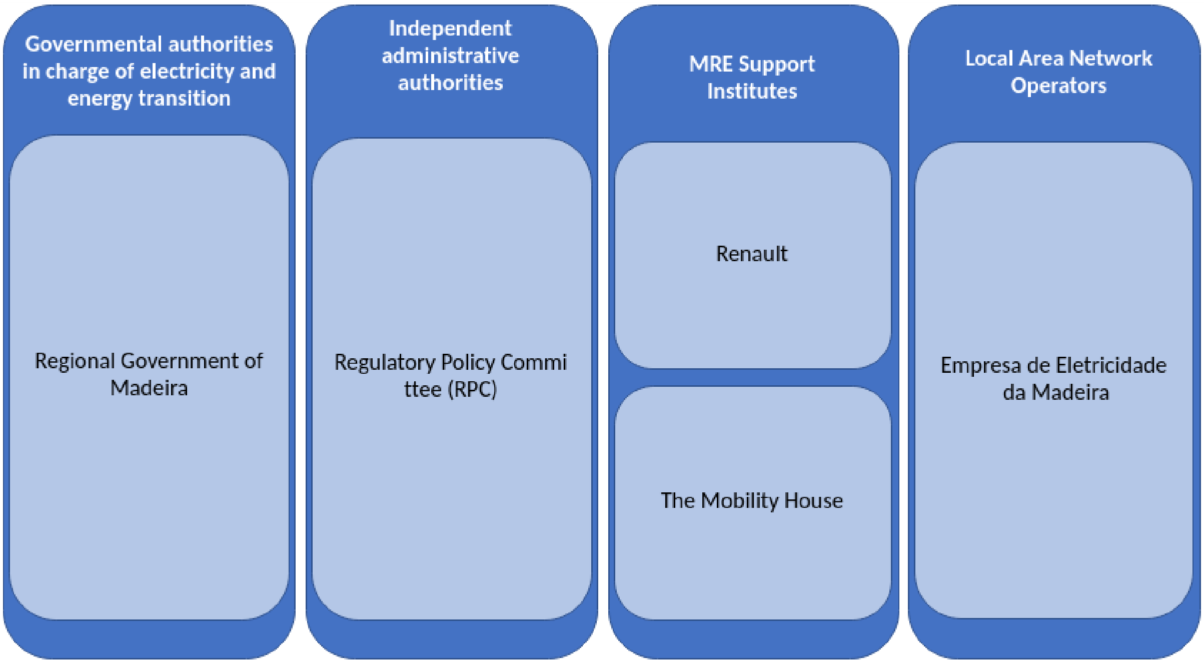


Figure 64 - Local actors of Porto Santo

4.20.4.2 Identification of existing programmes and current energy transition policies

The island of Porto Santo wants to become the first island in the world whose energy is produced 100% renewable. To achieve this, several solutions are being considered and are gradually being put in place.

Having equipped itself with photovoltaic panels to provide 2MW, the island wants to make the most of the sunshine it enjoys all year round and has already equipped itself with 4MW stationary batteries for energy storage.

The main programme in place on the island is Smart Fossil Free Island based on the use of the electric car grid to provide electricity to the whole Grid, this is called V2G (Vehicle to Grid). The principle is that the cars are recharged with the surplus electricity produced by the photovoltaic panels and when the grid is out of power, the cars give up their power to compensate for the loss in the grid.

This project is a collaboration between Renault (supplying the electric ZOE cars), the energy company Empresa de Electricidade da Madeira and the startup The Mobility House.

4.20.4.3 Assessment of the relevance of ongoing programmes and projects

The local government of Madeira has used EUR 400 000 to enable the purchase of electric cars. This V2G programme is innovative in their field and well advanced, however it requires the ability to provide users with a source of green power generation to supply electricity to the vehicles. If the vehicles are powered by non-renewable power generation, then bringing this 'unsuitable' power back into the system does not help the green transition process. It is therefore necessary to increase the supply of green production solutions (photovoltaic or wind power) to make the V2G project viable and highly scalable.

4.20.5 Contacts

Contacts for electricity supply and power grid management	* Electricity generator: Empresa de Electricidade da Madeira Website: https://www.eem.pt/pt/inicio/ Local number: +351 291 211 300 // 800 221 187
Contacts able to support the implementation innovative energy solutions by companies	* Renault Website: www.renault.fr * The mobility house (startup) internet: https://www.mobilityhouse.com/int_en/ Phone: 0049 / 89 4161 430 0
Research institutes and other contacts able to transmit elements to characterize renewable resources	* Meteoblue : https://www.meteoblue.com/fr/meteo/historyclimate/climatemodelled/ouessant_france_6618260 *The National Wind Speed (NOABL) : http://www.renew-reuse-recycle.com/noabl.pl?n=503 * Global Solar Atlas: https://globalsolaratlas.info/map

	* Copernicus Climate Data Store: https://cds.climate.copernicus.eu/cdsapp#!/home Ocean Weather https://www.oceanweather.com/data/

Table 57 - Contacts for Porto Santo

4.21 Pico et Sao Jorge, Archipelago of Azores [Portugal]

4.21.1 Island's presentation

The islands of Pico and Sao Jorge (20km apart) are two of the main constituent islands of the Azores, located 1600 kilometres from the coast of Portugal. They have a total of 24,671 inhabitants, with a density of 35.3 inhabitants/km² for Pico, the most inhabited of the two.

There is no electric cable connecting it to the mainland and produces its resources thanks to a diesel power plant on Pico and 40 kW thanks to a wave-powered generator.

4.21.2 Evaluation of electricity consumption

4.21.2.1 Electricity consumption on the island

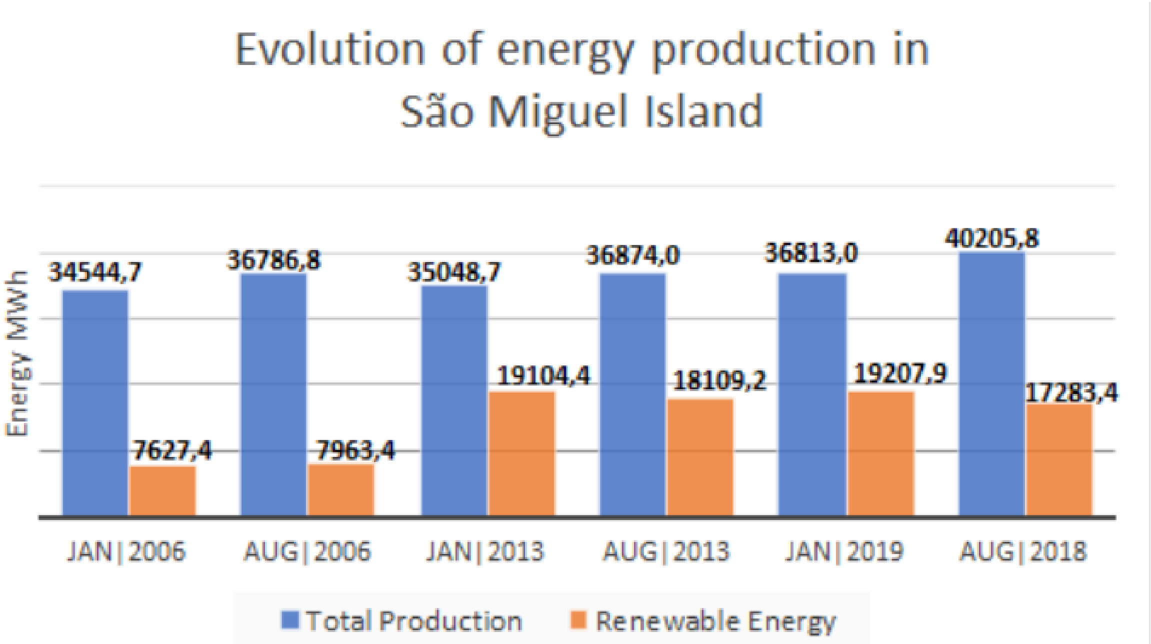


Figure 65 - Energy production in the Azores (renewable and non-renewable)

4.21.2.2 Consumption by consumer category and geographic area

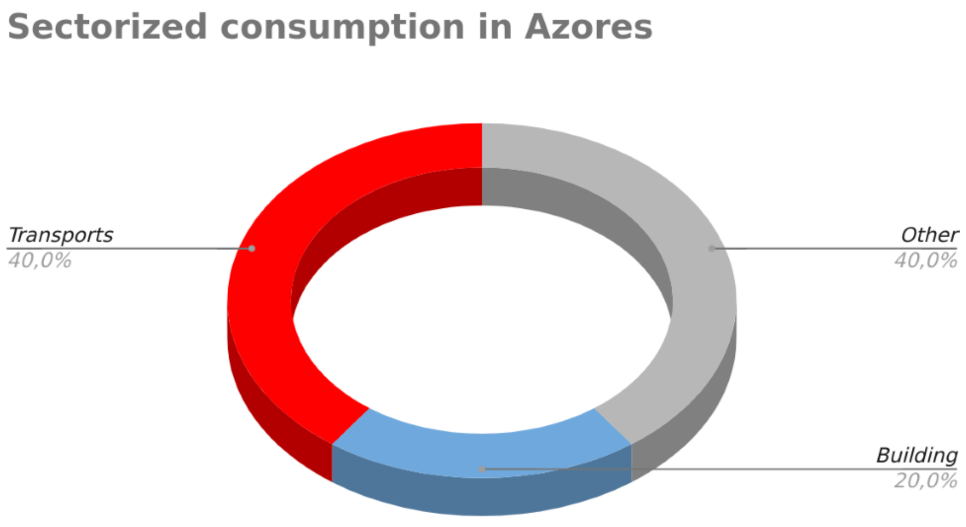


Figure 66 - Sectorized consumption in Azores

4.21.2.3 Consumption patterns

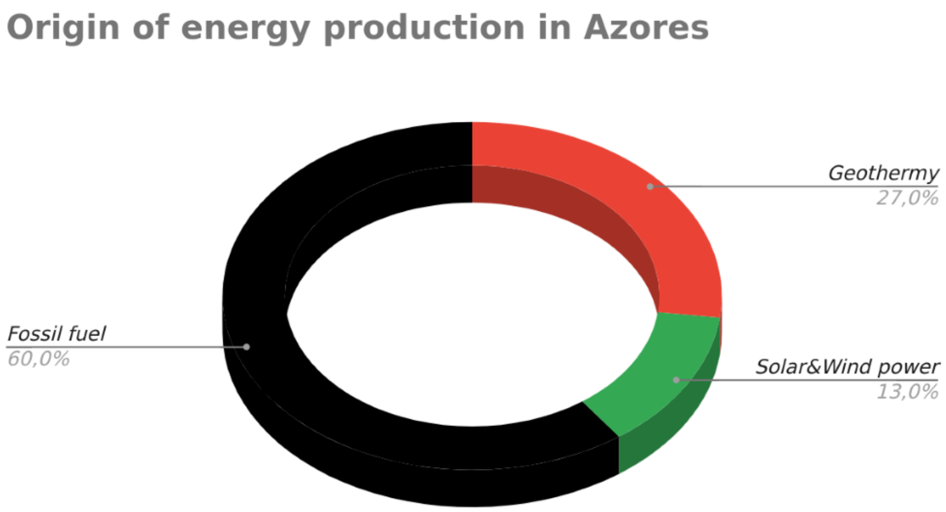


Figure 67 - Origin of energy production in Azores

The first wind turbine was installed in the Azores as early as 1988 and the archipelago also uses its geothermal potential to produce its energy in an eco-responsible way.

Due to its significant geographical isolation from the continents, the airplane remains a privileged means of providing resources. The 9 islands of the archipelago wish to move towards self-sufficiency and self-production of energy and especially clean (green) energy.

To move towards this transition, the island has set up the Azorean Energy Strategy, a plan for 2030 to guide and implement energy policies and a time guide for the next decade.

4.21.3 Evaluation of electricity production, transport and distribution means

4.21.3.1 Existing system

The following table shows the current system of electricity production in the Azores.

São Miguel Island	Generator	Wind turbine fields	Hydroline field	Geothermic
Energy sources	Fuel	Wind	Waves/currents	Geothermy
Producer	EDA			
Site	Caldeirão	Graminhais	Divers	Pico Vermelho & Ribeira Grande
Connection power (kW) / Capacity	98000	9000	5100	29600

Table 58 - System of electricity production in the Azores

4.21.3.2 Evaluation of the market for innovative technologies

As explained in Johan Daelman's preliminary study, characterizing the Marine Renewable Energy (MRE) resource is an expert work generally attributed to research institutes. Having had a brief introduction to the different types of information needed to characterize renewable resources, the objective is now simply to identify the institutes able to provide this kind of data for different renewable resources with a strong interest in MRE. Where some information is provided by the institutes or other documentation, it will be presented to illustrate the summary table.

In addition, the research carried out in the framework of this study has made it possible to access a lot of information related to this part via studies already carried out, websites, scientific articles, etc. The results gathered and deemed relevant will also be presented to give the reader a more precise idea of the renewable energy potential of this NZI.

The following summary table presents the institutes able to provide characterization data of the energy potential for each of the associated resources.

Type of resource	Institutes able to deliver resource characterization data
Tidal power from tides	For France (and Europe to some extent), the tide directory of the French Navy's hydrographic and oceanographic service (SHOM) serves as a reference for a wide choice of ports.
Energy tidal turbine outcome of currents	Ocean Weather Provide currents and waves trend around the world
Energy wave machine outcome of waves and tidal	Ocean Weather Provide currents and waves trend around the world
Eolienne energy	https://globalwindatlas.info The meteoblue platform shares local weather data for the whole world with a resolution of 30 km. Among other things, wind roses are offered. For greater accuracy, they offer high-resolution simulations with data for every hour.

Table 59 - Instances able to deliver resource characterization data for Azores

4.21.4 Evaluation of energy transition policies

4.21.4.1 Identification of local actors

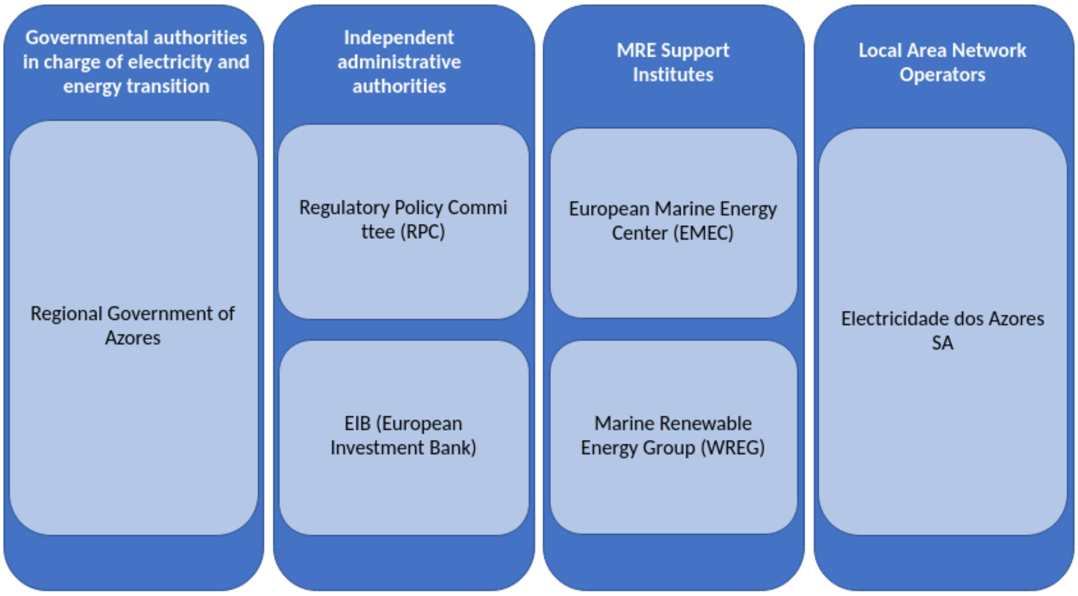


Figure 68 - Local actors of the Azores

4.21.4.2 Identification of existing programmes and current energy transition policies

The major asset of the Azores archipelago is its exceptional geothermal situation. It is very volcanic and at the meeting of 3 different tectonic plates, so it is not necessary to drill deep into its soil to obtain extremely hot water and use it in a geothermal power plant, which is what the archipelago does.

Two geothermal power plants are installed on the northern flank of the Fogo volcano (island of Sao Miguel) and produce 23 MW (Ribeira Grande-13 MW & Pico Vermelho-10 MW). These plants cover 45% of the population's energy needs.

In order to develop this virtually inexhaustible source of energy, the EIB has invested EUR 70 million in the form of a loan to develop this geothermal energy programme. To this end, the local authority plans to increase geothermal production on the island by 5MW and to set up a plant on Terceira to produce 3.5MW.

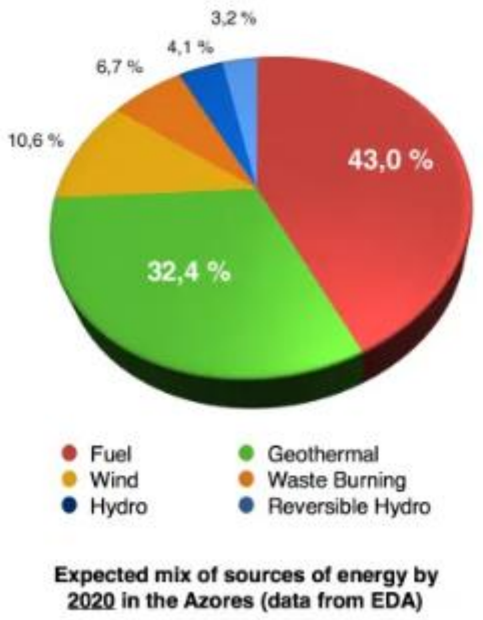


Figure 69 - Expected mix of sources of energy by 2020 in the Azores

At the same time, investments are being made in oil-fired power, allowing a 15.5MW increase in production. It is therefore necessary to set up a greener and more environmentally friendly energy grid, to eventually replace these 15.5MW of energy into 15.5MW of renewable energy.

4.21.4.3 Assessment of the relevance of ongoing programmes and projects

The establishment of geothermal production centres is well established in the archipelago, particularly on the islands of Sao Miguel and Terceira.

However, the main challenge for the archipelago remains the acceptance of the resource by the inhabitants. Indeed, geothermal energy certainly remains one of the least known means of energy production, and although this unknown is more and more accepted in the archipelago, communication on this resource and associated programs must be increased in order to allow its proper development.

The existing program must go hand in hand with the archipelago's other assets, namely its sunshine, winds and obvious marine (current) resource.

4.21.5 Contacts

Contacts for electricity supply and power grid management	* Electricity generator: Eda-electricidade Dos Azores Sa Website: https://www.eda.pt Local number: +351 296 202 000

Local authorities	* Town hall of Ponta Delgada Website: cm-pontadelgada.azoresdigital.pt Phone: +351 296 282 366 Mail: gabinetedomunicipe@mpdelgada.pt Mayor: Berta Correia A Melo Cabral
Research institutes and other contacts able to transmit elements to characterize renewable resources	* Meteoblue : https://www.meteoblue.com/fr/meteo/historyclimate/climatemodelled/ouessant_france_6618260 *The National Wind Speed (NOABL) : http://www.renew-reuse-recycle.com/noabl.pl?n=503 * Global Solar Atlas: https://globalsolaratlas.info/map * Copernicus Climate Data Store: https://cds.climate.copernicus.eu/cdsapp#!/home Ocean weather: https://www.oceanweather.com/data/

Table 60 - Contacts for the Azores

4.22 Isles of Raméa [Canada]

4.22.1 Island's presentation

The Raméa Islands, in the province of Newfoundland and Labrador, is a small Canadian archipelago, close to Saint-Pierre and Miquelon (90 kilometres) and about 250 kilometres from Nova Scotia. There are 526 inhabitants on the archipelago.

Not connected to the mainland by a submarine cable, this archipelago is completely electrically isolated. It produces about 700 kW of wind power. However, much of the island is powered by diesel generators and by hydrogen storage, which amounts to 250 kW of stored hydrogen. This island is already well on its way to becoming 100% clean and electrically independent.

4.22.2 Evaluation of electricity consumption

4.22.2.1 Electricity consumption on the island

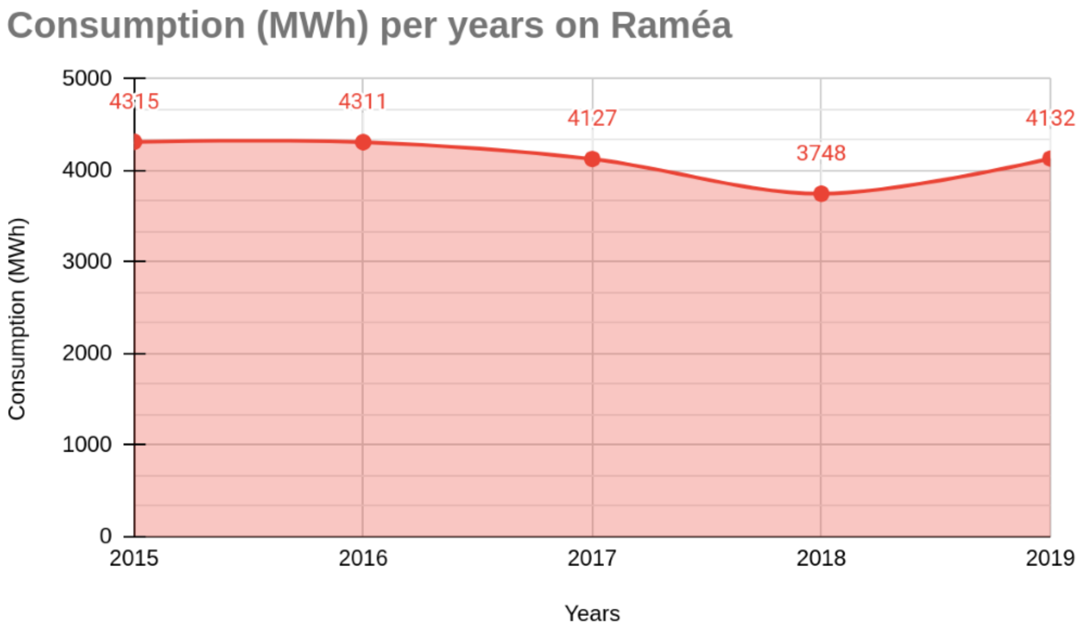


Figure 70 - Annual consumption on Raméa 2015/2019

Annual consumption on Raméa Island varies very little from one year to the next. It is contained between 4.1GWh and 3.7GWh.

4.22.2.2 Consumption by consumer category and geographic area

As the island is sparsely populated and motor vehicles are prohibited, there are no industrial or agricultural activities on the island. The island's economy is based on tourism.

Thus, the entire electricity consumption can be distributed among all the inhabitants, thus constituting a total residential pole.

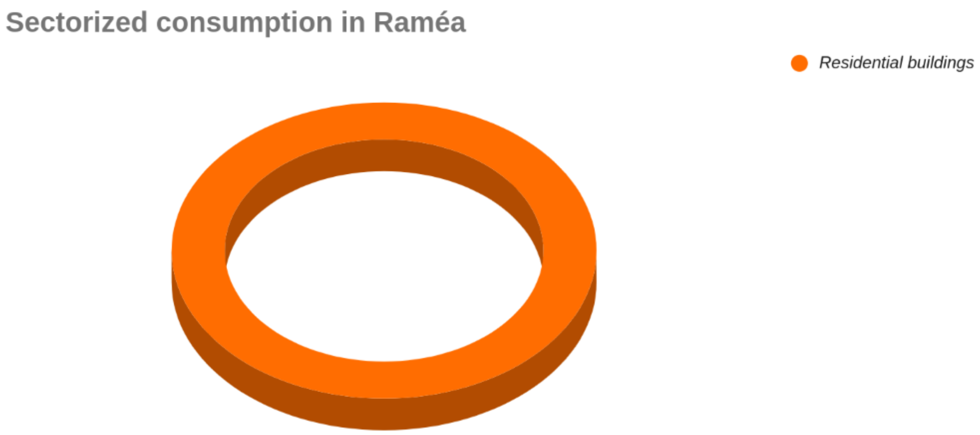


Figure 71 - Sectorized consumption in Raméa

4.22.2.3 Consumption patterns

We will present here the consumption pattern of the island of Raméa. The island has been part of a large project to test a wind power plant and the use of fuel cells (Dihydrogen) to produce electricity for the island's inhabitants.

This programme has enabled the island to slightly reduce its consumption of diesel fuel for its generators. This duality of technology makes it possible to have a "clean" source of electricity, whether there is wind (wind system) or not (fuel cells take over).

The distribution of this produced energy is possible thanks to electrical cables connecting the power plant to the terminals and electrical boxes.

4.22.3 Evaluation of electricity production, transport and distribution means

4.22.3.1 Existing system

The following table presents the current electricity production system on Raméa Island

	3 diesel generator	***Wind turbines***	***Dihydrogen Storage***
Energy source	Diesel	Wind	Storage
Site	Raméa		
Connecting power(kW) / Capacity	?	720	250

Table 61 - Electricity production system on Raméa Island

4.22.3.2 Evaluation of the market for innovative technologies

As explained in Johan Daelman's preliminary study, characterizing the Marine Renewable Energy (MRE) resource is an expert work generally attributed to research institutes. Having had a brief introduction to the different types of information needed to characterize renewable resources, the objective is now simply to identify the institutes able to provide this kind of data for different renewable resources with a strong interest in MRE. Where some information is provided by the institutes or other documentation, it will be presented to illustrate the summary table.

In addition, the research carried out in the framework of this study has made it possible to access a lot of information related to this part via studies already carried out, websites, scientific articles, etc. The results gathered and deemed relevant will also be presented to give the reader a more precise idea of the renewable energy potential of this NZI.

The following summary table presents the institutes able to provide characterization data of the energy potential for each of the associated resources.

Type of resource	Institutes able to deliver resource characterization data
Tidal Energy from Tides	For France (and Europe to some extent), the tide directory of the French Navy's hydrographic and oceanographic service (SHOM) serves as a reference for a wide choice of ports.
Tidal Energy from currents	Ocean Weather Provide currents and waves trend around the world
Wave energy from waves	Ocean Weather Provide currents and waves trend around the world
Wind energy	https://globalwindatlas.info The meteoblue platform shares local weather data for the whole world with a resolution of 30 km. Among other things, wind roses are offered. For greater accuracy, they offer high-resolution simulations with data for every hour.

Table 62 - Instances able to deliver resource characterization data for Raméa

4.22.4 Evaluation of energy transition policies

4.22.4.1 Identification of local actors

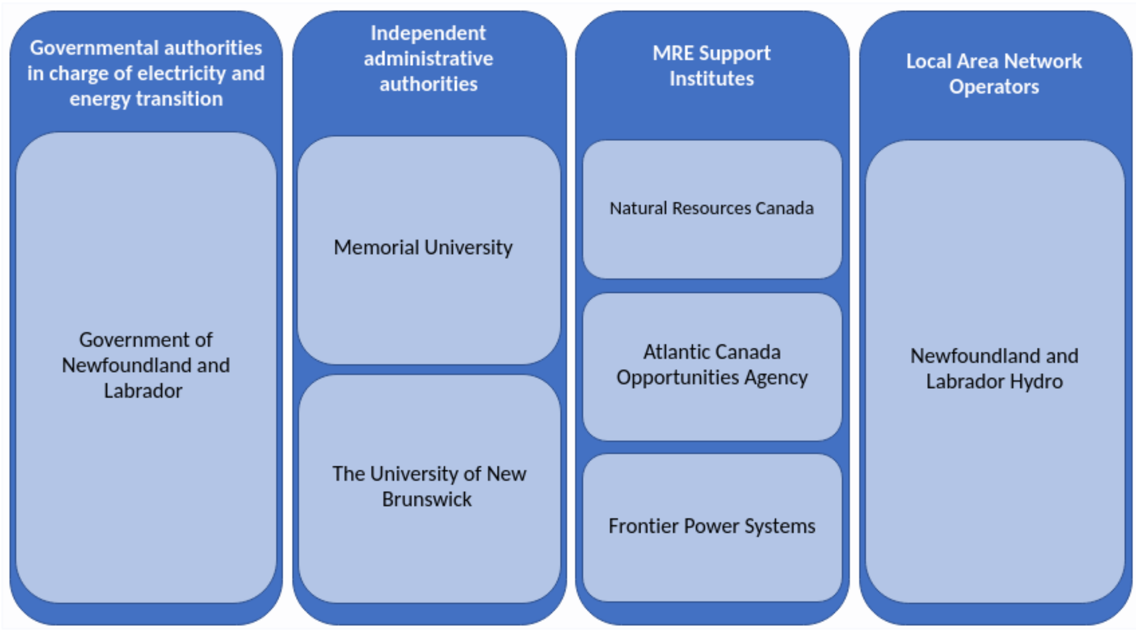


Figure 72 - Local actors of Raméa

4.22.4.2 Identification of existing programmes and current energy transition policies

From 2009, the island of Raméa, whose energy production is totally isolated from the national grid and consists of the use of 6 wind turbines and oil-fired generators, decides to launch a brand-new production program with different partners. The project consists of the establishment of 3 new wind turbines as well as the implementation of a dihydrogen generation and storage system.

The objective is that when the wind resource runs out, the stored dihydrogen is used to produce the energy resource, then any form of cut-off in the electricity grid is short-circuited.

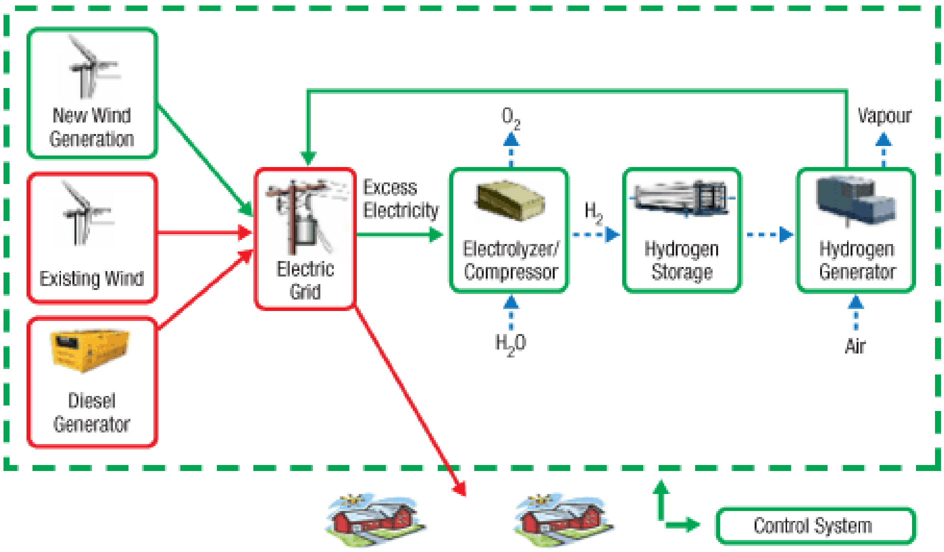


Figure 73 - Raméa electrical grid scheme

The dihydrogen generator is a 250kW generator.

This program therefore allows the island to have two green power resources, one of which is backup when the first one runs out.

4.22.4.3 Assessment of the relevance of ongoing programmes and projects

The program initiated in 2009 is not a success. Indeed, the electricity bills of the inhabitants continue to rise despite this project, whose goal (total energy independence) has not been achieved.

According to the local authorities, the 3 new wind turbines have been operating very little or not at all.

The diesel generators are still in use to provide power to the inhabitants and the wind-hydrogen co-gen co-generation is not or very little used on the island. There is therefore an ongoing conflict between the local authorities and the project manager, a financial conflict and a conflict of interest for the manager.

4.22.5 Contacts

Contacts for electricity supply and power grid management	* Electricity generator: Newfoundland and Labrador Hydro Website: https://nlhydro.com Local Number: 709.737.1400 Mail: hydro@nlh.nl.ca
Contacts able to support the implementation innovative energy solutions by companies	* Natural Resources Canada Phone: 343-292-6096 * Atlantic Canada Opportunities Agency Phone: 1-800-668-1010 Mail: ACOA.information.APECA@canada.ca.
Research institutes and other contacts able to transmit elements to characterize renewable resources	* Meteoblue : https://www.meteoblue.com/fr/meteo/historyclimate/climatemodelled/ouessant_france_6618260 *The National Wind Speed (NOABL) : http://www.renew-reuse-recycle.com/noabl.pl?n=503 * Global Solar Atlas: https://globalsolaratlas.info/map * Copernicus Climate Data Store: https://cds.climate.copernicus.eu/cdsapp#!/home Ocean weather: https://www.oceanweather.com/data/

Table 63 - Contacts for Raméa

4.23 Falkland Islands - Îles Malouines [United Kingdom]

4.23.1 Island's presentation

The Falklands are an archipelago in the South Atlantic situated 480 km off the coast of Argentina. The Falklands has a population of 3198 inhabitants, two thirds of whom live in the capital, Port Stanley, and has a population density of 0.26 inhabitants/km².

Not connected to the mainland by a submarine cable, the Falklands are completely isolated electrically. Energy production relies mainly on diesel generators and wind power. The current installed capacity on the island is 8.58 MW, of which 1.98 MW is wind power. The wind farms have reduced diesel consumption by 1.4 million litres per year.

In addition, there is a willingness on the part of the island territory to develop renewable energy sources on its territory in order to decarbonize its electricity production and diversify its energy mix. The transition strategy consists of exploiting the vast local energy potential and replacing current diesel production. The Falklands have indeed a huge potential of renewable resources. They have already begun their energy transition by carrying out evaluations and experiments on solar energy and hydroelectricity, but wind energy has the most promising future.

4.23.2 Evaluation of electricity consumption

The data below comes from the site of the American company Knoema, which manages databases from different regions of the world.

First of all, we find the evolution of electricity consumption on the Falklands over a large period from 1980 to 2017. Generally speaking, it can be seen that this has gradually increased until 2017. Nevertheless, significant peaks in consumption were observed in 1988 as well as in 2008 and 2009 and in 2015. Despite the peak in 2015, annual consumption seemed to have stabilised since 2012 below the 16,000 MWh mark.

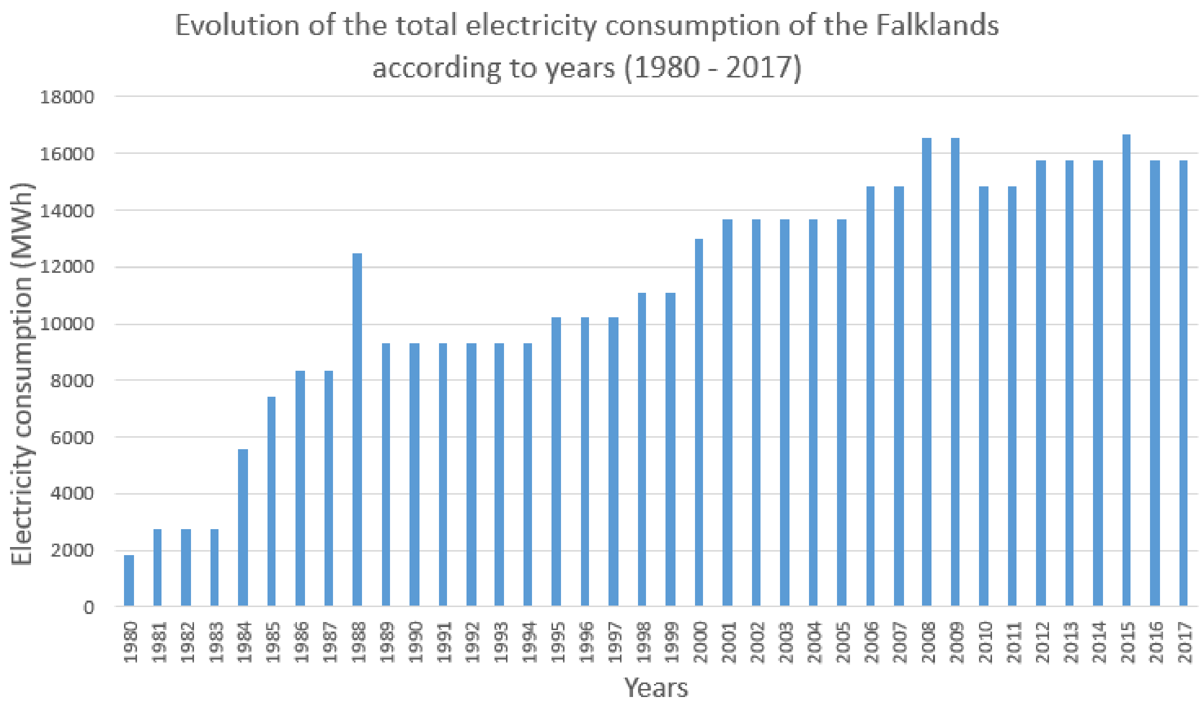


Figure 74 - Evolution of the annual electricity consumption of the Falklands (1980-2017)

Other data concerning the island's electricity consumption, whether on a monthly or daily basis, the breakdown of electricity consumption by category of consumer or the particularities of the consumption pattern, could not be obtained despite the efforts made to find them. In fact, many websites were visited and searched in depth in order to find these data. It seems that they are simply not freely available and accessible. The Knoema company's website has other headings than annual electricity consumption, but you have to take out a subscription to access them.

Nevertheless, several local contacts have been solicited but without response to date. The following table lists the authorities contacted for the Falklands:

Authority	Contact details
United Kingdom Falkland Islands Trust	exec.sec@ukfit.org
The Falkland Islands Development Corporation	develop@fidc.co.fk
Falkland Islands Government (London Office)	reception@falklands.gov.fk
Falkland Islands Government (Stanley Office)	info@sec.gov.fk

Table 64 - Authorities contacted for access to Falklands electricity consumption data

4.23.3 Evaluation of electricity production, transport and distribution means

4.23.3.1 Existing system

The following table shows the different systems of electricity production on the Falklands.

	Diesel generators	Wind farm	Photovoltaic panels
Sector / power supply	Diesel	Wind	Solar
System description	Stanley Generating Station	6 Enercon wind turbines	Small add-on systems
Site	Stanley (capital city)	Near Stanley	Isolated dwellings on the island
Date of commissioning	Before 2002	3 in 2007 and then 3 in 2010	Since 2015
Connecting power / Capacity	6.6 MW	1980 kW (330 kW each)	In general, system capacity from 1.5 kW to 6kW

Table 65 - Existing system for Falklands

The installation of three 330 kW Enercon wind turbines in 2007 reduced the annual fuel consumption of the Stanley plant by 26% and reduced the cost of electricity. Three more turbines of the same type were installed in 2010, bringing average output to 40 per cent of the island's needs, and on some days the turbines provided more than half of the power required.

In addition, it is important to note that there is no island wide power grid as the population is too dispersed. In fact, several farms (more than a hundred) are spread over the entire island. In the past, these farms depended solely on diesel generators for power, but this was expensive and provided electricity for only a few hours a day. Farmers then became aware of the potential for exploiting wind energy and today, thanks to the financial support of the IFCD, 85% of farms have electricity produced 24 hours a day from wind energy.

In addition, the Rural Energy Partnership Development Programme has been developed and implemented from 2015 to support housing in rural areas. In particular, five projects have been developed to reduce the amount of diesel energy at five different locations in the Falklands. The technologies tested are:

- Photovoltaic solar panels
- Thermal solar panels
- Wind turbines

The three solar photovoltaic projects were installed in 2016 and production data showed encouraging results, with the reduction of diesel consumption at the three sites by 18,532 litres. The other two projects had not yet been installed in 2018 due to a lack of skilled labour.

As part of the study, essential information on the current electricity generation systems was identified on the Falkland Islands. However, the large number of isolated houses and farms did not allow a comprehensive assessment of all means of electricity production to be made. In general, isolated properties are equipped with a hybrid model consisting of diesel generators (about 15 to 25 kW), photovoltaic panels (1.5 to 6 kW), a few wind turbines (about 2.5 kW each) and batteries for electricity storage.

4.23.3.2 Evaluation of the market for innovative technologies

As explained in Johan Daelman's preliminary study, characterizing the Marine Renewable Energy (MRE) resource is an expert work generally attributed to research institutes. Having had a brief introduction to the different types of information needed to characterize renewable resources, the objective is now simply to identify the institutes able to provide this kind of data for different renewable resources with a strong interest in MRE. Where some information is provided by the institutes or other documentation, it will be presented to illustrate the summary table.

In addition, the research carried out in the framework of this study has made it possible to access a lot of information related to this part via studies already carried out, websites, scientific articles, etc. The results gathered and deemed relevant will also be presented to give the reader a more precise idea of the renewable energy potential of this NIA.

The following summary table presents the institutes capable of delivering characterisation data on the energy potential for each of the associated resources for the Falklands.

<table>
<tr><th>Type of resource</th><th>Institutes able to deliver resource characterisation data</th></tr>
<tr><td>Tidal Energy from Tides</td><td rowspan="5">The British Oceanographic Data Centre (BODC) is a national body responsible for the conservation and dissemination of data on the marine environment. It is the designated marine science data centre for the United Kingdom and is part of the National Oceanography Centre (NOC). It maintains and develops the National Oceanographic Database (NODB), whose marine data are mainly derived from UK research institutions. It manages the data of the UK Tide Gauge Network which is part of the National Tide & Sea Level Facility (NTSLF). The BODC is also one of six designated data centres that manage NERC environmental data.

The United Kingdom Hydrographic Office (UKHO) is a UK agency that provides hydrographic and marine data to mariners and maritime organizations around the world.</td></tr>
<tr><td>Tidal Energy from currents</td></tr>
<tr><td>Wave energy from waves</td></tr>
<tr><td>Osmotic energy</td></tr>
<tr><td>The thermal energy of the seas</td></tr>
<tr><td>Wind energy</td><td>The National Wind Speed (NOABL) database provides average wind speeds over a 1 km x 1 km area for the whole of the UK at heights of 10 m, 25 m and 45 m above ground.

The meteoblue platform shares local weather data for the whole world with a resolution of 30 km. Among other things, wind roses are offered. For greater accuracy, they offer high-resolution simulations with data for every hour.</td></tr>
<tr><td>Solar energy</td><td>The EU Joint Research Centre's solar modelling software, PVGIS, estimates the potential for energy production that can be achieved by photovoltaic solar technology on the basis of average solar irradiation for a given geographical location.

The Global Solar Atlas also provides quick and easy access to data on solar resources around the world.</td></tr>
</table>

Table 66 - Presentation of the institutes providing renewable resource data for the Falkland Islands

4.23.4 Evaluation of energy transition policies

4.23.4.1 Identification of local actors

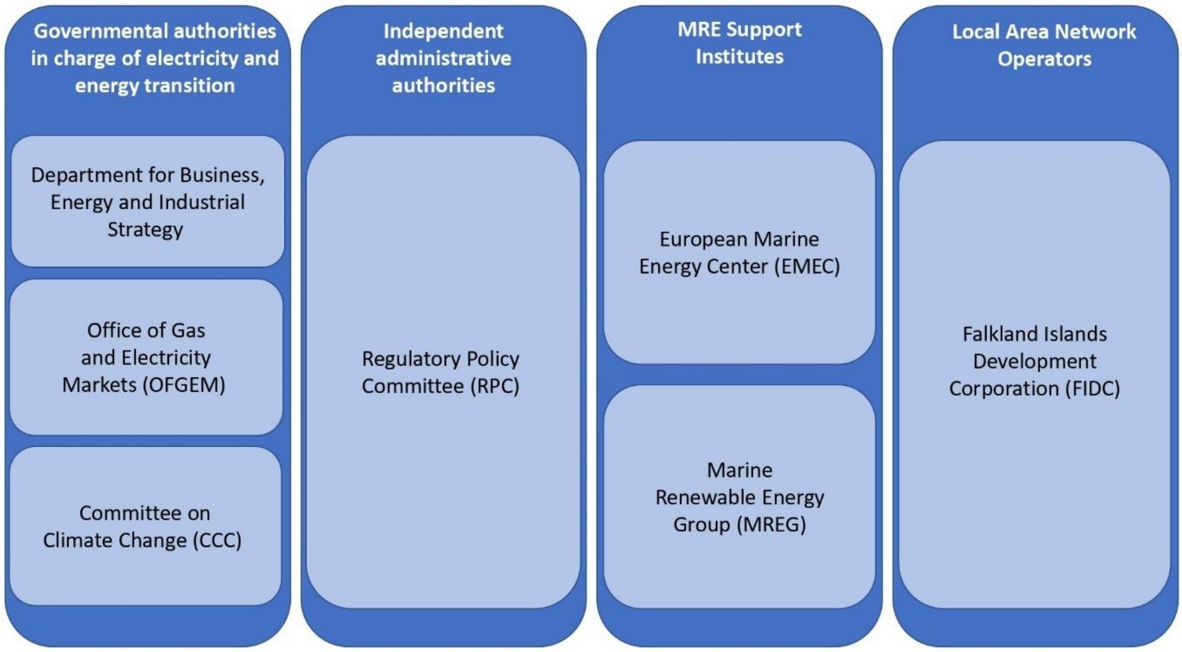


Figure 75 - Local actors of the Falklands

4.23.4.2 Identification of existing programmes and current energy transition policies

The geographical situation of the Falkland Islands necessarily implies a very high import price for fossil fuels. Therefore, since 1996 the Falkland Islands Government has invested in an environmentally friendly policy to increase its use of renewable energy sources. It is working with the Falkland Islands Development Corporation (FIDC) and consumers to develop this energy and ecological transition. It has also worked with the National Renewable Energy Laboratories (NREL), which is a U.S. laboratory dedicated to the study, development, commercialization and implementation of technologies in the field of renewable energy and energy efficiency. The transition strategy is to exploit the vast local energy potential and replace current diesel production. However, there is no transmission network as such since the two Falklands islands are mainly composed of villages of about 35 people. The island benefits from wind energy which is its only source of cheap, green and abundant energy. The annual average is 16 knots or more than 8.2 m/s. In 10% of the cases, the wind exceeds 34 knots, i.e. more than 17 m/s.

Wind power accounts for 37% of electricity production, with the remainder being produced by diesel generators. In 2007, the government completed the installation of three new wind turbines on the island, reducing the annual fuel consumption of the nearby thermal power plant by 26%. And in 2010, the completion of the second phase of the wind farm concluded with the installation of three more turbines and three flywheels to increase the efficiency of the hybrid wind-diesel system by storing energy. The third phase of the wind farm development will be energy storage, achieved by charging a 2 MWh battery during periods of optimal wind and discharging the battery when wind is not available. Farms in the rural areas of the island now use more than 85 per cent of their electricity needs from wind power. In addition, at the end of 2012, the Falklands Government signed an agreement with the British Forces of the South Atlantic Islands to build another wind farm to provide wind power, under a 15-year contract, to the local military base.

Although the utility has been experimenting with hydroelectric and solar power, the island's wind resources far exceed the potential resources for either technology. The Falkland Islands are therefore studying how to make greater use of wind, including by considering additional energy storage and heat pump technologies to further reduce the consumption of fossil fuels.

Nevertheless, the Falkland Islands are actively continuing its research on the Sea Lion oil field in the north of the island. The field is in the early stages of exploration and analysis based on the latest data indicates the presence of mobile crude oil. The island's company hopes to begin development of the field in the future.

Overall, the Falkland Islands' objective is to reduce the demand for energy from fossil fuels and to increase the use and types of sustainable energy technologies, although some projects may be in contradiction with this policy. Since 2016, several projects have emerged such as the increasing implementation of solar panels as well as systems to optimise peak wind energy production.

4.23.4.3 Assessment of the relevance of ongoing programmes and projects

Therefore, in view of the share of renewable energies in the energy mix of this British island, there is still a market with great potential to lead the Falklands towards a 100% renewable energy transition. Even if wind power has a clear advantage in terms of efficiency, any other innovative technology would reduce the consumption of fossil fuels and this is reinforced by the intermittent nature of wind power. The multiplicity of systems exploiting renewable energy sources will always be an advantage in meeting the energy needs of this island whose geographical situation is atypical.

4.23.5 Contacts

Contacts for electricity supply and power grid management	*** Falkland Island Development Corporation (FIDC)** Email: develop@fidc.co.fk et ruralenergy@fidc.co.fk Glenn Ross Power Station Manager at Falkland Islands Government https://www.linkedin.com/in/glenn-ross-48397480/
Competent local authorities	***Falkland Islands Government representative in London:** Phone number: +44 (0)20 7222 2542 Email:reception@falklands.gov.fk *** Falkland Islands Government representative in Stanley:** Phone number: +500 27451 Email: info@sec.gov.fk Website: https://www.falklands.gov.fk/

Contacts able to support the implementation innovative energy solutions by companies	*** Falkland Islands Association (FIA)** Website: https://www.fiassociation.com/contact Phone number: 0203 764 0824 *** UK Falkland Islands Trust (UKFIT)** Website: https://www.ukfit.org/contacts/ Phone number: +44(0)2072222542 Email: exec.sec@ukfit.org
Research institutes and other contacts able to transmit elements to characterise renewable resources	*** BODC:** https://www.bodc.ac.uk/data/all-data.html ***Platform of meteoblue:** https://www.meteoblue.com/fr/meteo/historyclimate/climatemodelled *** PVGIS:** https://ec.europa.eu/jrc/en/pvgis *** Global Solar Atlas:** https://globalsolaratlas.info/map *** Copernicus Climate Data Store:** https://cds.climate.copernicus.eu/cdsapp#!/home

Table 67 - Contacts for the Falklands

4.24 King Island, Tasmania [Australia]

4.24.1 Island's presentation

King Island is an island located between Australia and Tasmania, 90 kilometres from each other. 1585 people live on the island, which has a population density of 1.5 inhabitants/km2.

The island is electrically insulated and produces its electricity using diesel generators, wind turbines, solar panels and a 3MW (1.5 MWh) storage battery. Its total installed generation capacity is 8.84 MW. Electricity generation in this system includes wind, diesel and solar. The island has already begun an energy transition process by installing smart meters that have been deployed to the inhabitants to monitor photovoltaic production and record customers' energy consumption in real time. This energy transition has reduced the system's CO_2 emissions while improving the overall reliability and quality of the island's power grid.

4.24.2 Evaluation of electricity consumption

After multiple attempts to contact the island's local authorities, we did not receive any response. We are not able to present consumption data for this island.

4.24.3 Evaluation of electricity production, transport and distribution means

4.24.3.1 Existing system

The island’s electricity generation and storage system is described in the section 4.24.4.2 Identification of existing programmes and current energy transition policies.

4.24.4 Evaluation of energy transition policies

4.24.4.1 Identification of local actors

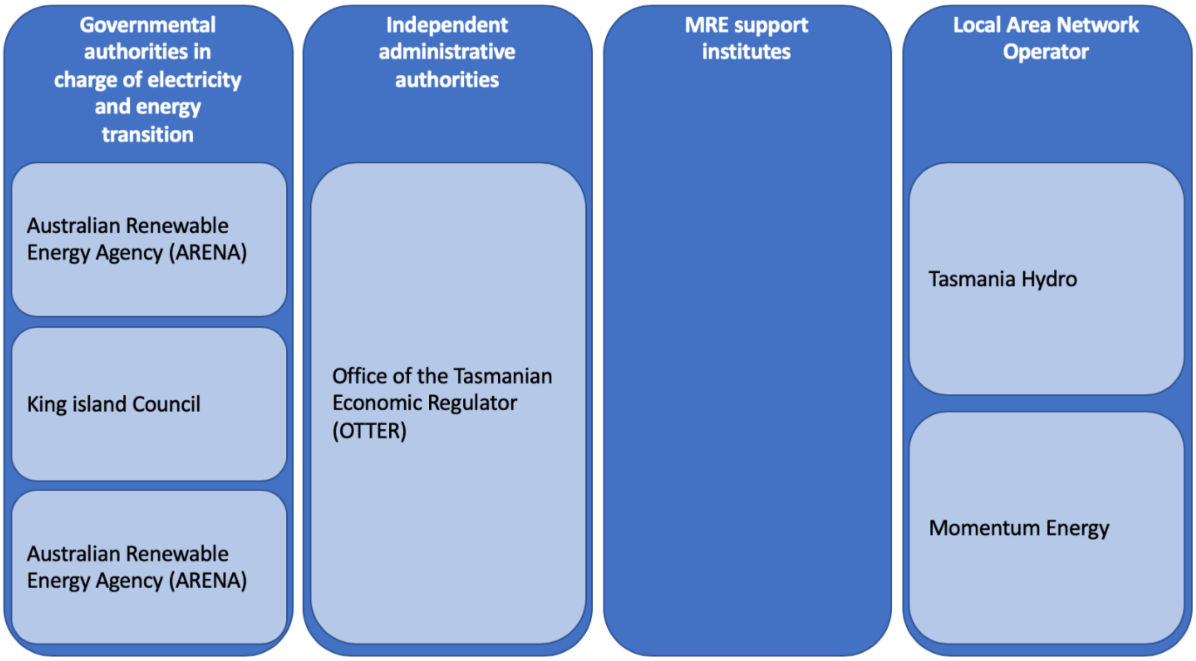


Figure 76 - Local actors for King Island

4.24.4.2 Identification of existing programmes and current energy transition policies

The King Island Renewable Integration Project (KIREIP) was an initiative of Hydro Tasmania, with the assistance of the Australian Renewable Energy Agency (ARENA) to develop a world-leading, hybrid off-grid power system to supply 65% of King Island’s energy needs using renewable energy. The system is capable of 100% renewable operation, the first megawatt class off-grid system with this capability in the world. The project started in 2011 with the installation of wind turbines generating 2.45 MW and solar panels generating 470 kW. The second phase of the project was to stabilise the production and distribution of electricity using batteries, flywheels and a dynamic resistor. The diesel generator was kept can now operate on biodiesel. The whole system is now considered as one of the most advanced in the world.

In 2019, the Australian company Wave Swell Energy developed a marine energy generator that creates electricity using the swell of the sea. The generator is at the trial stage but is now connected to the island's grid.

4.24.4.3 Assessment of the relevance of ongoing programmes and projects

Since the end of this massive project, the local authorities seam very pleased with their technologically advanced solution. Thus, the potential market is not very promising. It also seems that Australian companies are mainly involved in the development of the grid and power generation solutions.

4.24.5 Contacts

Contacts for electricity supply and power grid management	* Production d'électricité : Hydro Tasmania Mail : contactus@hydro.com.au Phone: +61 3 6240 2898 Web site: https://www.hydro.com.au * Distribution de l'electricity : Momentum Energy Phone: 1800 627 228 Web site: https://www.momentumenergy.com.au
Local authorities	* Conseil de King island Mail : kicouncil@kingisland.tas.gov.au Phone: (03) 6462 9000 Web site: https://kingisland.tas.gov.au

Table 68 - Contacts for King island

5 Enlargement

To understand the choice of these 24 islands, it is interesting to talk about the islands that we had also initially identified but that we did not select for this project. This allows us to understand even more our selection criteria and to justify the interest of the selected islands.

Many islands in the English Channel were not selected primarily because of their large population and high energy consumption. This is for example the case of Jersey and Guernsey.

Secondly, the most discriminating criterion in the search for NIAs is obviously the presence of a submarine cable linking these islands to the national grid. The French islands of Hoëdic, Houat, Belle-Île or Groix are examples of islands that are of less interest in this project because of their link with the mainland. However, for some selected islands a cable does exist. The choice of these islands is based on three findings. Firstly, there are not 24 electrically isolated islands in the Channel. The framework of the project encouraged us to favour islands in or around the English Channel rather than remote islands, so we have instead selected islands connected by submarine cable offering a significant energy potential. The second observation is the fact that some submarine cables are sometimes faulty or prone to breakdowns, as in the case of the island of Kythnos in Greece. An innovative solution for islands in this situation is beneficial for them and fits perfectly within the framework of the ICE project. Finally, significant geographical isolation generates significant maintenance costs for islands connected by cable. This is why the island of Heligoland was selected despite the presence of a submarine link with Germany.

Another criterion that led to the rejection of certain islands was their proximity to the coast. This is the case, for example, of the islands of Friesland in the Netherlands and Germany, as well as certain islands in Denmark such as the islands of Fohrh, Amrum, Sejero and the French islands of Batz and Bréhat. Other islands were also of interest but were mainly excluded from our selection because they were linked by submarine cable or even overhead lines and their prioritisation criteria were less relevant than for the 24 selected NIAs. These islands include the Scottish islands of Colonsay and Gigha, the Irish island of Inishbofin and the island of Kökar near Finland.

Outside Europe, other islands also seemed interesting to us such as the island of Boa Vista in Cape Verde, the Canary archipelago, the Japanese island of Miyakojima, the Australian island of Necker Island and an island in Ecuador called Floreana in the Galapagos archipelago. In France, the islands of Groix, Belle-île-en-Mer, Aix and Yeu also attracted our attention in a pronounced way.

6 Conclusion

6.1 Goals of this report

This report is a working tool to identify, understand and map 24 NZIs in the Channel, in Europe and to a greater extent around the world. By recalling what an NZI is, this report provides elements for the identification, selection and characterisation of the current energy situation, and more particularly the electricity situation, of 24 NZIs. The aim of this project is to provide selected companies with information on potential markets for territories operating in local energy loops. These 24 territories have a strong willingness to be included in a global process of energy production via MRE or any other renewable resource. Several selection criteria, plus prioritisation criteria, were used to select 24 final NZIs, all of which are islands.

Firstly, a mapping of the selected NZIs is present in order to allow a quick identification and an easy localization of these NZIs. Then, each island is presented in detail. Many aspects have been addressed in order to accurately identify markets with high potential. It should be noted that the report also provides an extension, corresponding to the islands not selected via our criteria but whose energy supply system study could prove interesting.

6.2 Presentation of the 8 ZNIs with the strongest potential market for the implementation of MRE technologies

This study has therefore made it possible to detail with great precision many of the characteristics of each island. As a conclusion, we have selected 6 different criteria to evaluate and give a score out of 10 to each island. The best scores, higher than 8/10, concern the following islands as shown in the table below:

Rank	*Island*	*Mark (on 10)*
1	Sark	9
2	Inishmore	8.3
3	Rathlin Island	8.3
4	Island of Molène	8.3
5	Ushant Island	8.3
6	Chausey	8.2

7	Ile-de-Sein	8.2
8	Aurigny	8

Table 69 - The eight most interesting island of the study

The results are shown in the following 8 graphs, called speed cameras. The graphs of the other NZIs are presented in the appendix and the detailed presentation of each evaluation criterion as well as the explanation of the associated scores are presented in the following section.

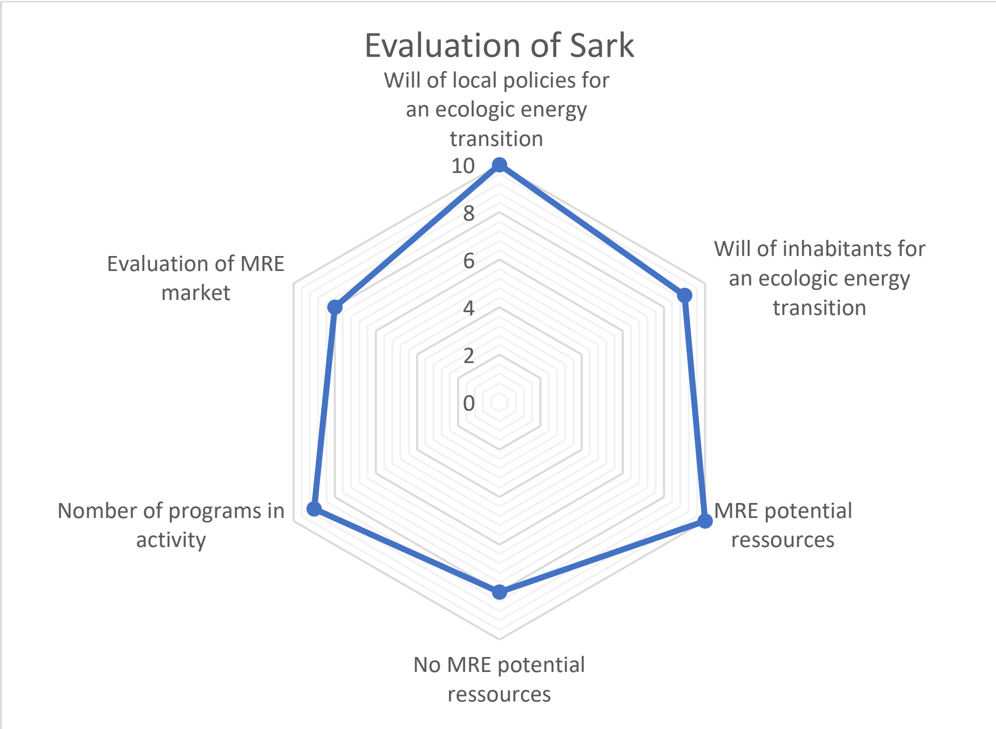


Figure 77 - Evaluative star of Sark

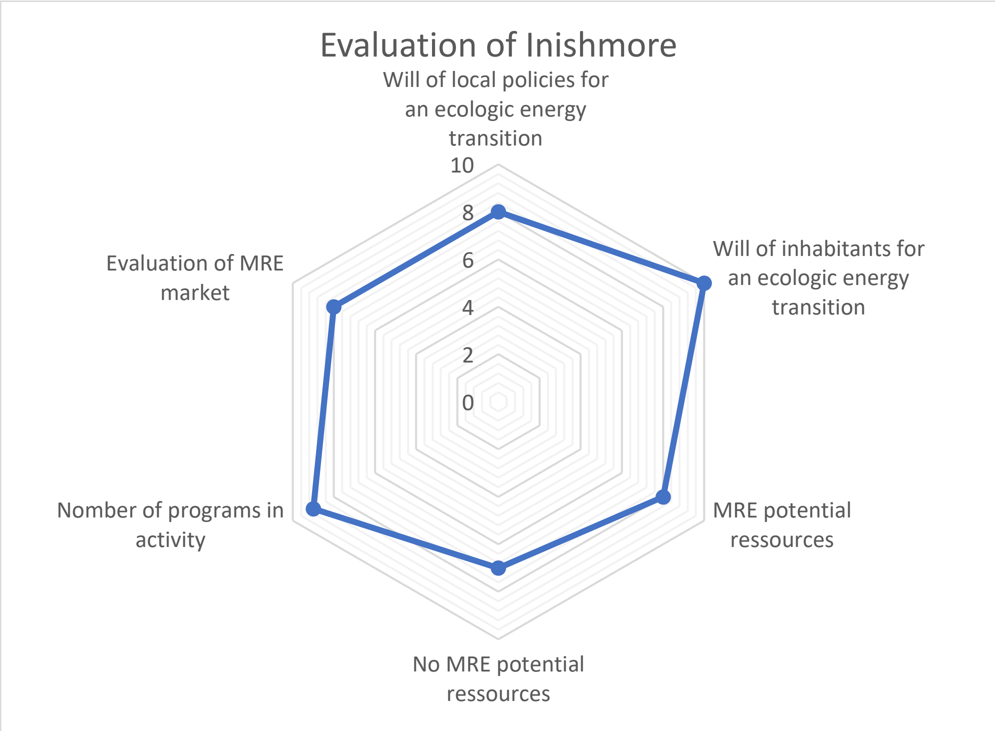


Figure 78 - Evaluative star of Inishmore

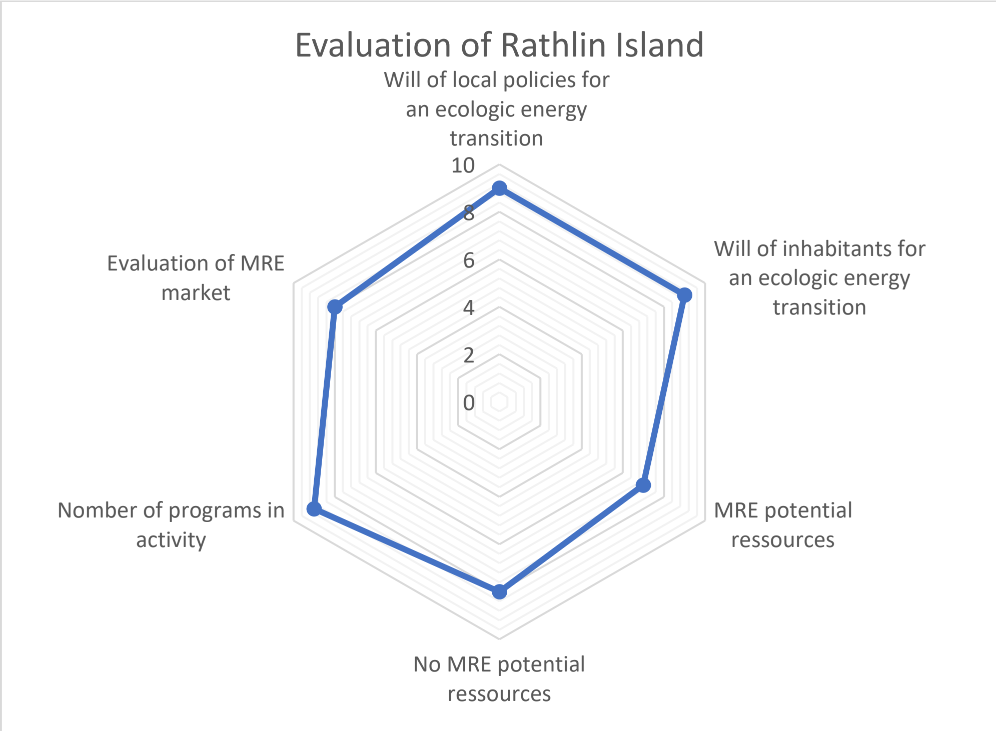


Figure 79 - Evaluative star of Rathlin Island

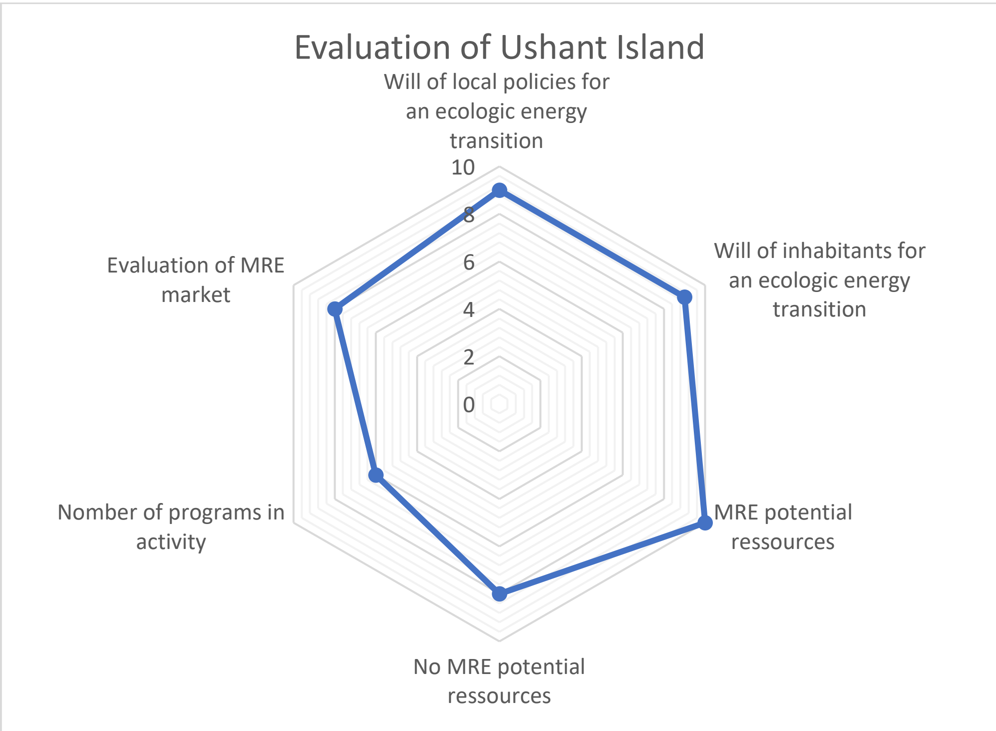


Figure 80 - Evaluative star of Ushant Island

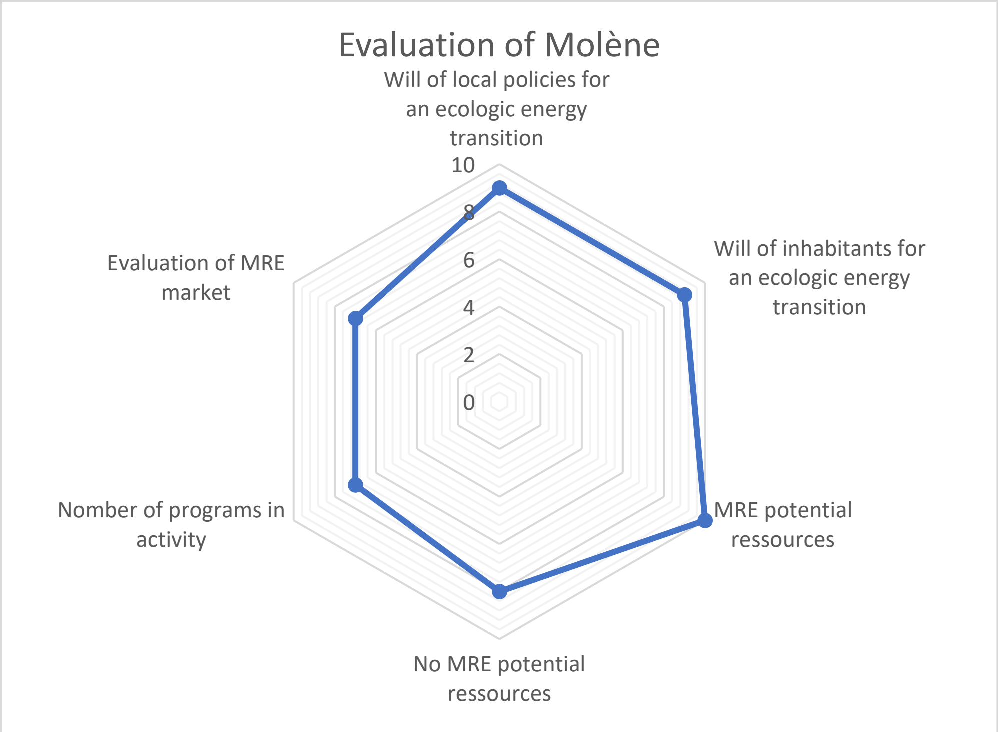


Figure 81 - Evaluative star of the island of Molène

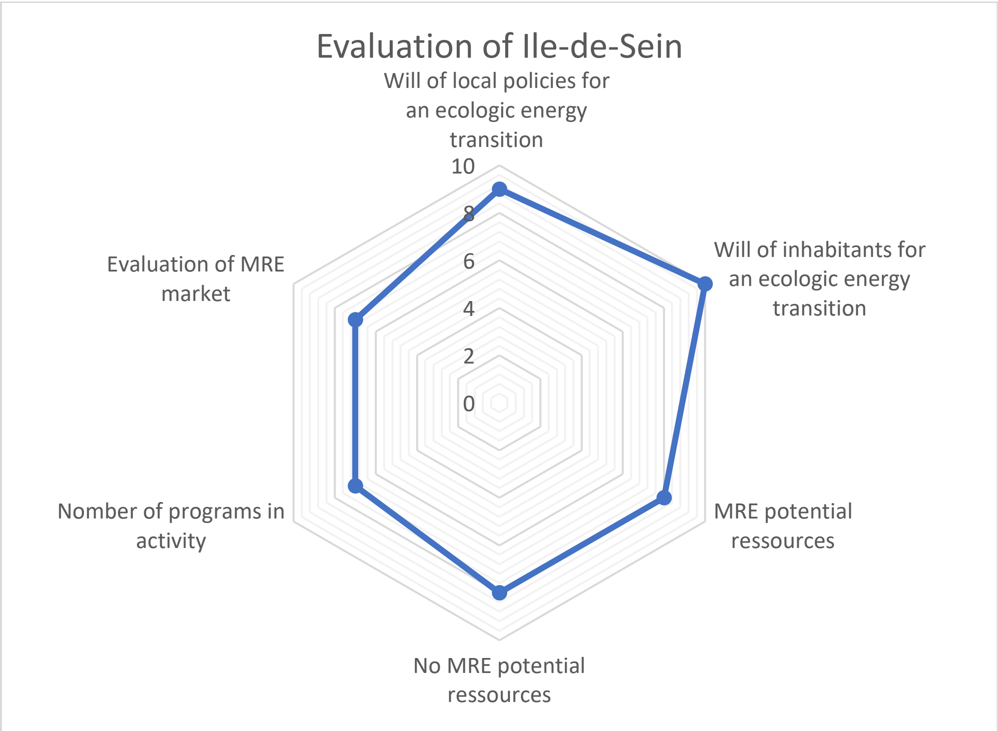


Figure 82 - Evaluative star of Ile-de-Sein

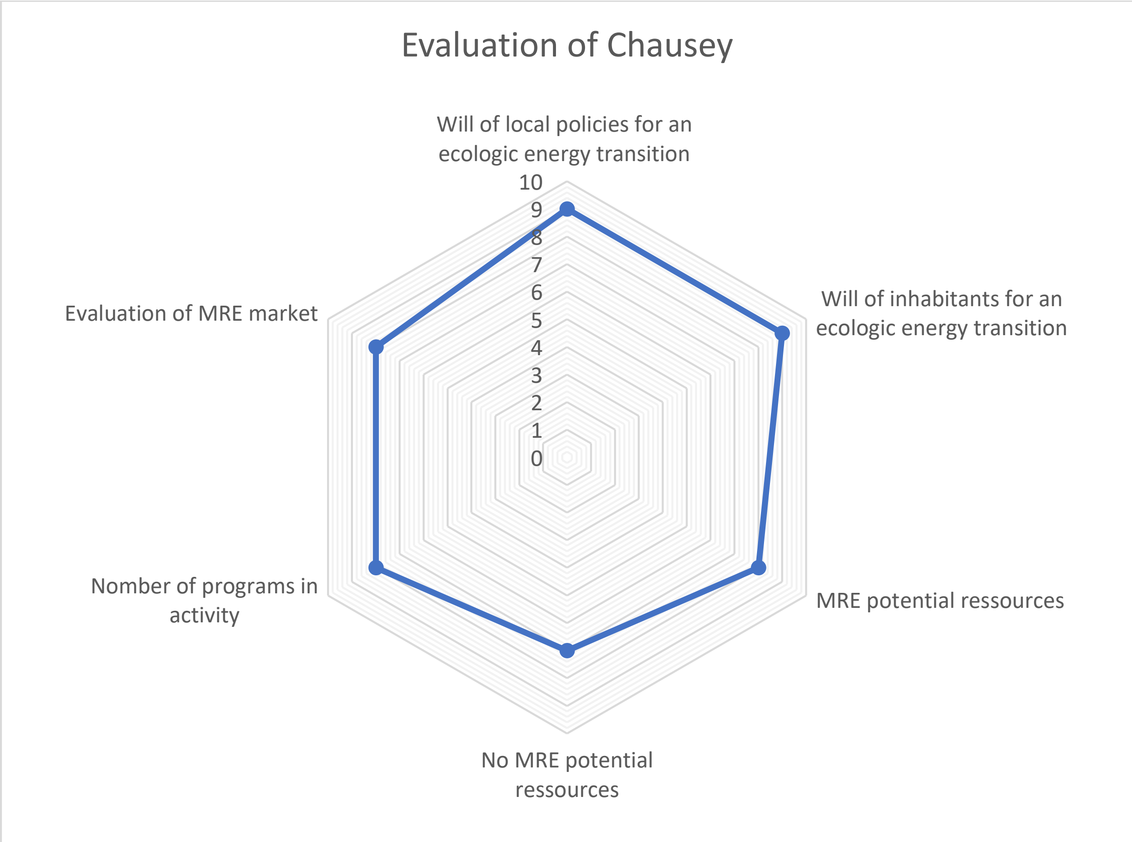


Figure 83 - Evaluative star of Chausey

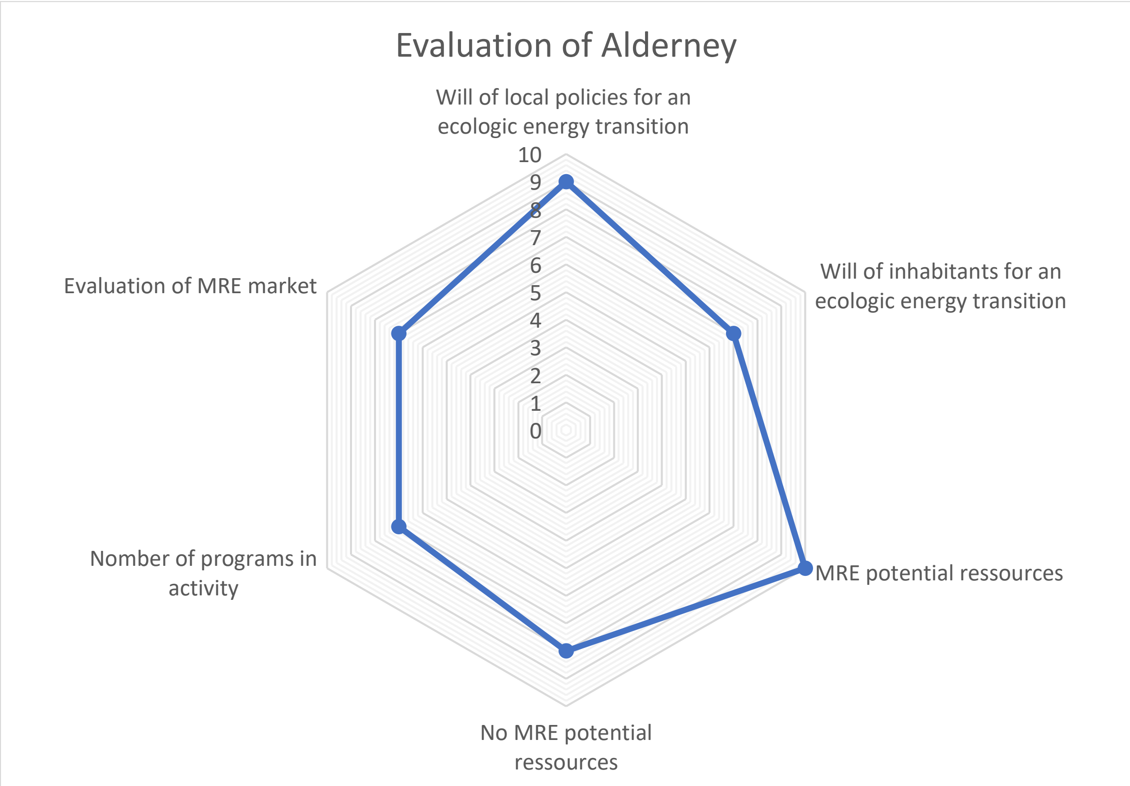


Figure 84 - Evaluative star of Alderney

6.3 Explanation of the evaluation criteria

The criteria for the conclusions we have chosen to provide an evaluative rating of the various NIZs are 6, namely:

- **Will of local policies for an ecologic energy transition**: This criterion assesses the extent to which local political authorities (town hall, department, head of region, etc.) are inclined to want to make a strong energy transition in their NIA from a fossil fuel-based to a clean and renewable source of food. The higher this score, the more local authorities wish to make this transition.

Mark	Evaluation
0 to 3	Local authorities do not want and do not think about renewable solutions in their area.
4 to 6	Local authorities are a little sceptical or have yet to be convinced by renewable solutions but remain open to dialogue.
7 to 10	The local authorities are fully committed to renewable solutions and wish to use these technologies throughout the NIA.

- **Will of inhabitants for an ecologic energy transition**: This criterion assesses the extent to which local citizen communities (associations, citizen groups, etc.) are inclined to want to make a strong energy transition in their NIA from a fossil fuel source to a clean and renewable source of food. The higher this score, the more local citizen communities want to make this transition.

Mark	Evaluation
0 to 3	Local citizen communities do not want and do not think about renewable solutions in their area.
4 to 6	Local citizen communities are a little sceptical or have yet to be convinced by renewable solutions but remain open to dialogue.
7 to 10	Local citizen communities are fully committed to renewable solutions and wish to use these technologies throughout the NIA.

- **MRE potential resources**: This criterion assesses both the presence and the potential for exploitation of a resource applicable to MRE. For example, an NIA that is subject to strong tidal currents and/or high waves throughout the year will receive a high score for this criterion in view of the potential for the application of MRE technologies.

Mark	Evaluation
0 to 3	The NZI has no climatic and structural potential for the application of MRE technologies.
4 to 6	The NZI has some potential in terms of MRE applications but the network will not be able to be completely supplied thanks to them. The data currently available do not allow a relevant evaluation.
7 to 10	The NZI has very large potentialities allowing a serene and perennial application of MRE technologies.

- **No MRE potential resources**: This criterion assesses both the presence but also the potential for exploitation of a resource applicable to non-MRE renewable energies, such as non-offshore photovoltaic or onshore wind. An NZI, for example, subject to strong sunshine throughout the year will receive a high score for this criterion in view of the potential for the application of photovoltaic technologies.

Mark	Evaluation

0 to 3	The NZI has no climatic and structural potential for the application of renewable energy technologies.
4 to 6	The NZI has some potential in terms of renewable energy applications, but the network will not be able to be completely supplied by them.
7 to 10	The NZI has very large potentialities allowing a serene and perennial application of renewable energy technologies.

- **Number of programs in activity:** This criterion is used to assess the number of major and ongoing NZI programs. This criterion is extremely important because it provides a direct indication of whether the island has already begun its energy transition through MRE, or whether, despite the island's strong desire, few or no companies in the sector have begun to apply their technologies to the NZI. The assessment is made in this way:

Mark	Evaluation
0 to 3	With many ecological transition programs launched, NZI is already generating power through clean energy production systems.
4 to 6	Some ecological transition programmes are at the end of their reflection or have been launched, but green energy coverage is still incomplete.
7 to 10	Very few, if any, ecological transition programs initiated or under consideration.

- **Evaluation of MRE market**: Criterion for characterising the market, i.e. an evaluative rating of the potential and success for an MRE company wishing to set up in the NZI.

Mark	Evaluation
0 to 3	The MRE market is completely saturated on the NZI where the MRE potential is really limited.
4 to 6	Companies or programmes are already well established in the area, but action is still possible. MRE potential exists but is not significant.
7 to 10	The market is virtually or completely open to MRE companies. The potential for MRE is largely present.

Figures and tables

Bibliography

Oscar Fitch-Roy, G. J. (2018). ICE report 2.1.1 : Smart peripheral territories transitions : Litterature review and current status. University of Exeter.

« 8cd4bc453f190a45306ea6d7381e0285eabdbba4.pdf ». s. d. Visited July 13, 2020.

https://agence-api.ouest-france.fr/uploads/article/8cd4bc453f190a45306ea6d7381e0285eabdbba4.pdf?v=135.

« 20_02_2017_Eurelectric_report_towards_the_energy_transition_on_europes_islands.pdf ». s. d. Visited July 13, 2020. http://www.elecpor.pt/pdf/20_02_2017_Eurelectric_report_towards_the_energy_transition_on_europes_islands.pdf.

« Global Human Settlement - Visualisation - European Commission ». s. d. Consulté le 13 juillet 2020. https://ghsl.jrc.ec.europa.eu/visualisation.php#.

« Grid Map ». s. d. Visited July 13, 2020. https://www.entsoe.eu/data/map/.

« Islands_Microgrid_Profiles_Islands_Global_Remote_Communities_CaseStudy_2015.pdf ». s. d. Visited July 13, 2020. https://rmi.org/wp-content/uploads/2017/04/Islands_Microgrid_Profiles_Islands_Global_Remote_Communities_CaseStudy_2015.pdf.

« Map Features - OpenStreetMap Wiki ». s. d. Visited July 13, 2020. https://wiki.openstreetmap.org/wiki/Map_Features.

« Open Infrastructure Map ». s. d. Visited July 13, 2020. https://openinframap.org/#13.82/48.4613/-5.09386.

« overpass turbo ». s. d. Visited July 13, 2020. https://overpass-turbo.eu/.

« Transition énergétique ». s. d. *Îles du Ponant* (blog). Visited July 13, 2020. https://www.iles-du-ponant.com/transition-energetique/.

The Glénan, Ile-de-Sein, Island of Molène, Ushant Island :

« Archipel des Glénan ». s. d. *Îles du Ponant* (blog). Visited July 13, 2020. https://www.iles-du-ponant.com/iles/archipel-des-glenan/.

« Dossier-de-presse_Saint-Nicolas_des_Glenan.pdf ». s. d. Visited July 13, 2020. https://www.enedis.fr/sites/default/files/field/documents/Dossier-de-presse_Saint-Nicolas_des_Glenan.pdf.

« glénan laboratoire microgrids ». s. d. *Think Smartgrids* (blog). Visited July 13, 2020. https://www.thinksmartgrids.fr/actualites/glenan-laboratoire-microgrids.

« L'archipel des Glénan ». s. d. Tourisme Bretagne. Visited July 13, 2020. https://www.tourismebretagne.com/destinations/les-10-destinations/quimper-cornouaille/larchipel-des-glenan/.

« L'archipel des Glénan en Bretagne ». s. d. Fouesnant-les-Glénan. Visited July 13, 2020. https://www.tourisme-fouesnant.fr/notre-destination/lieux-a-decouvrir/archipel-de-reve/.

« L'archipel des Glénan vise le 100% énergies renouvelables en 2021 ». s. d. Visited July 13, 2020. https://www.20minutes.fr/planete/2540099-20190614-bretagne-archipel-glenan-vise-100-energies-renouvelables-2021.

« L'électricité de Saint-Nicolas des Glénan sera 100 % renouvelable en 2021 | Enedis ». s. d. Visited July 13, 2020. https://www.enedis.fr/actualites/lelectricite-de-saint-nicolas-des-glenan-sera-100-renouvelable-en-2021.

« L'environnement, une mode ? Non, un mode de vie | Glenans ». s. d. Consulté le 13 juillet 2020. https://www.glenans-avenir.org/actualites/lenvironnement-une-mode-non-un-mode-de-vie--1738.

« L'île d'Ouessant se branche sur le courant marin ». s. d. Visited July 13, 2020. https://www.20minutes.fr/planete/680948-20110304-planete-l-ile-ouessant-branche-courant-marin.

« Ouessant : la turbine de l'hydrolienne Sabella réinstallée avec succès ». s. d. France 3 Bretagne. Visited July 13, 2020. https://france3-regions.francetvinfo.fr/bretagne/finistere/ouessant-turbine-hydrolienne-sabella-reinstallee-succes-1733837.html.

« Ouessant, Sein et Molène visent 100% d'énergie renouvelable d'ici 2030 ». 2017. *Le Monde de l'Energie* (blog). 22 september 2017. https://www.lemondedelenergie.com/ouessant-sein-molene-renouvelables/2017/09/22/.

Rédaction, La. 2017. « Les îles d'Ouessant et de Sein testent un nouveau système de pilotage énergétique intelligent baptisé EMS ». *Les Smartgrids* (blog). 10 october 2017. https://les-smartgrids.fr/iles-ouessant-sein-systeme-pilotage-energetique-intelligent-ems/.

« Saint-Nicolas des Glénan | RESERVES NATURELLES DE FRANCE ». s. d. Visited July 13, 2020. http://www.reserves-naturelles.org/saint-nicolas-des-glenan.

« Transition énergétique : les îles bretonnes à la pointe - Le Journal des Entreprises - Finistère ». s. d. Visited July 13, 2020. https://www.lejournaldesentreprises.com/finistere/article/transition-energetique-les-iles-bretonnes-la-pointe-277250.

« Transition énergétique : les îles bretonnes gardent le cap ». s. d. Visited July 13, 2020. https://www.bretagne-economique.com/actualites/transition-energetique-les-iles-bretonnes-gardent-le-cap.

« Un chauffe-eau solaire pour Drenec | Glenans ». s. d. Visited July 13, 2020. https://www.glenans.asso.fr/actualites/un-chauffe-eau-solaire-pour-drenec--1747.

Grande-île :

« La transition énergétique sur l'Île de Chausey ». s. d. Visited July 13, 2020. https://www.echosciences-normandie.fr/articles/la-transition-energetique-sur-l-ile-chausey.

Sercq/Sark :

BBC News. 2015. « Sark Considers Undersea Energy Cable », 25 March 2015, sect. Guernsey. https://www.bbc.com/news/world-europe-guernsey-32048219.

« L'île aux vassaux fantômes - Libération ». s. d. Visited July 13, 2020. https://www.liberation.fr/grand-angle/2006/10/18/l-ile-aux-vassaux-fantomes_54597.

« Sark Electricity's Equipment ». s. d. Visited July 13, 2020. http://www.sarkelectricity.com/Specifications.htm.

Robinson, Shamir, Savvas Papadopoulos, Eulalia Jadraque Gago, et Tariq Muneer. 2019. « Feasibility Study of Integrating Renewable Energy Generation System in Sark Island to Reduce Energy Generation Cost and CO2 Emissions ». *Energies* 12 (24): 4722. https://doi.org/10.3390/en12244722.

Aurigny/Alderney :

« Alderney to Upgrade Power Plant ». s. d. Visited July 13, 2020. https://www.guernseypress.com/news/2017/11/15/alderney-to-upgrade-power-plant/.

« Alderney to Upgrade Power Plant ». ———. s. d. Visited July 13, 2020. https://www.guernseypress.com/news/2017/11/15/alderney-to-upgrade-power-plant/.

« Interconnexion France-Aurigny-Grande Bretagne (FAB) ». 2014. RTE France. 26 november 2014. https://www.rte-france.com/fr/projet/interconnexion-france-aurigny-grande-bretagne-fab.

Scilly :

« Electricity | Public Services ». s. d. Visited July 13, 2020. https://www.islesofscillyholidays.co.uk/public-services/electricity.html.

« Smart Islands ». s. d. Smart Islands. Visited July 13, 2020. https://smartislands.org.

« Smart Islands Project | Hitachi in Europe ». s. d Visited July 13, 2020. https://www.hitachi.eu/en/smart-islands.

Wired UK. 2018. « How Tech Is Helping the Isles of Scilly Protect the Environment », 21 november 2018. https://www.wired.co.uk/article/renewable-energy-is-helping-the-isles-of-scilly-environment.

Lundy Island:

« Bideford Town Council - Lundy Island ». s. d. Visited July 13, 2020. https://www.bideford-tc.gov.uk/10-about-the-town/392-lundy-island.

« c_e_lundy_island_energy_assessment.pdf ». s. d. Visited July 13, 2020. http://www.aardvarkem.co.uk/downloads/c_e_lundy_island_energy_assessment.pdf.

« Electricity Produced by Generators - 1st Level Science ». s. d. BBC Bitesize. Visited July 13, 2020. https://www.bbc.co.uk/bitesize/clips/zrgxvcw.

« Lundy (île) ». 2020. In *Wikipédia*. https://fr.wikipedia.org/w/index.php?title=Lundy_(%C3%AEle)&oldid=169736651.

« Lundy Island | The Landmark Trust ». s. d. Visited July 13, 2020. https://www.landmarktrust.org.uk/lundyisland/.

says, T. F. LOUGHER. 2013. « Exploring Lundy Island ». *National Trust Places* (blog). 12 november 2013. https://ntplanning.wordpress.com/2013/11/12/exploring-lundy-island/.

Eigg :

« Eigg (Scotland) | Clean Energy For EU Islands ». s. d. Visited July 13, 2020. https://www.euislands.eu/island/eigg.

Rathlin Island:

« About Rathlin | Rathlin Community ». s. d. Visited July 13, 2020. http://www.rathlincommunity.org/about.

« Description Rathlin Island | characterization island | 2018 - 2019 ». s. d. Visited July 13, 2020. http://www.islandseurope.com/description.php?island=rathlin_island.

« Île de Rathlin ». 2020. In *Wikipédia*. https://fr.wikipedia.org/w/index.php?title=%C3%8Ele_de_Rathlin&oldid=172261453.

« Market Overview ». 2016. Utility Regulator. 19 octobre 2016. https://www.uregni.gov.uk/market-overview.

« Northern Ireland Authority for Energy Regulation ». s. d. GOV.UK. Visited July 13, 2020. https://www.gov.uk/government/organisations/northern-ireland-authority-for-energy-regulation.

« Rathlin – a community based vision for an island’s energy transition | Clean Energy For EU Islands ». s. d. Visited July 13, 2020. https://euislands.eu/island/rathlin.

« Rathlin Island ». 2020. In *Wikipedia*. https://en.wikipedia.org/w/index.php?title=Rathlin_Island&oldid=966801760.

Clare :

« Clare Island Fisherman Takes Action to Stop Fibreoptic Cable Project off Co Mayo ». s. d. The Irish Times. Visited July 13, 2020. https://www.irishtimes.com/business/technology/clare-island-fisherman-takes-action-to-stop-fibreoptic-cable-project-off-co-mayo-1.4252666.

« Population by Off Shore Island, Sex and Year - StatBank - data and statistics ». s. d. Visited July 13, 2020. https://statbank.cso.ie/px/pxeirestat/Statire/SelectVarVal/Define.asp?Maintable=CNA17&Planguage=0.

Inishmore :

« Aran Islands (Ireland) | Clean Energy For EU Islands ». s. d. Visited July 13, 2020. https://euislands.eu/island/aran-islands.

Cape Clear Island :

« Cape Clear (Ireland) | Clean Energy For EU Islands ». s. d. Visited July 13, 2020. https://euislands.eu/island/cape-clear.

« Des îles dans le vent | Les Echos ». s. d. Visited July 13, 2020. https://www.lesechos.fr/industrie-services/energie-environnement/des-iles-dans-le-vent-1037190.

Heligoland :

« Heligoland ». 2020. In Wikipedia. https://en.wikipedia.org/w/index.php?title=Heligoland&oldid=966837056.

« The Tiny Islands at the Heart of Germany's Offshore Wind Boom - Renewable Energy World ». s. d. Visited July 13, 2020. https://www.renewableenergyworld.com/2015/07/10/the-tiny-islands-at-the-heart-of-germany-s-offshore-wind-boom/.

Ventotene :

« 20_02_2017_Eurelectric_report_towards_the_energy_transition_on_europes_islands.pdf ». s. d. Visited July 13, 2020. http://www.elecpor.pt/pdf/20_02_2017_Eurelectric_report_towards_the_energy_transition_on_europes_islands.pdf.

« dossier_isole_sostenibili_2018.pdf ». s. d. Visited July 13, 2020. https://www.legambiente.it/wp-content/uploads/dossier_isole_sostenibili_2018.pdf.

« L'énergie des vagues, un moteur pour les îles d'Italie ». s. d. Visited July 13, 2020. https://www.lesaffaires.com/dossier/changements-climatiques-des-solutions-d-affaires/l-energie-des-vagues-un-moteur-pour-les-iles-d-italie/591390.

« Ventotene ». 2020. In *Wikipédia*. https://fr.wikipedia.org/w/index.php?title=Ventotene&oldid=171225763.

Salina :

« Salina (Italy) | Clean Energy For EU Islands ». s. d. Visited July 13, 2020. https://www.euislands.eu/island/salina.

« SALINA_FinalTransitionAgenda_20191118.pdf ». s. d. Visited July 13, 2020. https://euislands.eu/sites/default/files/2019-11/SALINA_FinalTransitionAgenda_20191118.pdf.

https://www.euislands.eu/sites/default/files/EUIslands_Salina_REMapping_20200709.pdf

Kythnos :

BVBA, Zenjoy. s. d. « Kythnos · WiseGRID ». Zenjoy.Be. Visited July 13, 2020. https://www.wisegrid.eu/pilot-sites/kythnos.

« fact sheet Kythnos.pdf ». s. d. Visited July 13, 2020. https://cdn.nimbu.io/s/76bdjzc/assets/fact%20sheet%20Kythnos.pdf.

« VARTA Storage provides energy stabilising system to Kythnos ». s. d. Visited July 13, 2020. https://www.power-technology.com/news/varta-storage-kythnos/.

Tilos :

Oscar Fitch-Roy, G. J. (2018). ICE report 2.1.1 : Smart peripheral territories transitions : Litterature review and current status. University of Exeter.

« HOME - TILOS Horizon ». s. d. Visited July 13, 2020. https://www.tiloshorizon.eu/.

Porto Santo :

« Des îles dans le vent | Les Echos ». s. d. Visited July 13, 2020. https://www.lesechos.fr/industrie-services/energie-environnement/des-iles-dans-le-vent-1037190.

Nouvelle, L'Usine. 2019. « Comment l'île de Porto Santo récupère l'énergie des Renault Zoé - L'Usine Auto », novembre. https://www.usinenouvelle.com/article/comment-l-ile-de-porto-santo-recupere-l-energie-des-renault-zoe.N882315.

Açores :

« Des équipements de production et de transport d'énergie d'origine renouvelable pour les Açores ». s. d. Visited July 13, 2020. https://www.eib.org/projects/regions/european-union/portugal/project-renewable-energy-and-electricity-transmission-in-the-azores.htm.

« Des îles dans le vent ». 2019. Les Echos. 11 July 2019. https://www.lesechos.fr/industrie-services/energie-environnement/des-iles-dans-le-vent-1037190.

« Géothermie aux Açores, un exemple à suivre à la Caraïbe? » 2017. *Caribbean Green Energy* (blog). 13 July 2017. https://caribbeangreenenergy.com/geothermie-aux-acores-exemple-a-suivre-a-caraibe/.

Malouines-Falkland Island, Raméa, King Island :

Bunker, K. *et al.* (2015) 'Renewable Microgrids: Profiles from Islands and Remote Communities Across the Globe'

Canada, Natural Resources. 2009. « Ramea Island ». Natural Resources Canada. 7 July 2009. https://www.nrcan.gc.ca/energy/energy-sources-distribution/renewables/wind-energy/ramea-island/7319.

Crighton, Andrew. s. d. « Rural Energy Partnership Development Scheme Project Review », 19.

« Economic Development ». s. d. King Island Council. Visited July 13, 2020. *https://kingisland.tas.gov.au/develop/economic-development/.*

« file.pdf ». s. d. Visited July 13, 2020. *https://www.fidc.co.fk/library/rural-development/413-final-report/file.*

Government of Canada, National Energy Board. 2020. « NEB – Provincial and Territorial Energy Profiles – Newfoundland and Labrador ». 24 June 2020. https://www.cer-rec.gc.ca/nrg/ntgrtd/mrkt/nrgsstmprfls/nl-eng.html#:~:text=In%202017%2C%20annual%20electricity%20consumption,more%20than%20the%20national%20average.

« Governor to Falkland Islands Delivers Annual Address to Legislative Assembly ». s. d. GOV.UK. Visited July 13, 2020. *https://www.gov.uk/government/speeches/governor-to-falkland-islands-delivers-annual-address-to-legislative-assembly.*

« Islands_Microgrid_Profiles_Islands_Global_Remote_Communities_CaseStudy_2015.pdf ». s. d. Visited July 13, 2020. *https://rmi.org/wp-content/uploads/2017/04/Islands_Microgrid_Profiles_Islands_Global_Remote_Communities_CaseStudy_2015.pdf.*

Jun 10, CBC News · Posted:, 2018 3:30 PM NT | Last Updated: June 10, et 2018. 2018. « Ramea Wind Project at a Standstill as Residents Worry about High Power Rates | CBC News ». CBC. 10 juin 2018. https://www.cbc.ca/news/canada/newfoundland-labrador/ramea-wind-power-project-at-standstill-1.4695679.

« King Island ». s. d. Visited July 13, 2020. *https://www.hydro.com.au/clean-energy/hybrid-energy-solutions/success-stories/king-island.*

« Renewable Energy | Falkland Islands Government ». s. d. Visited July 13, 2020. *https://www.falklands.gov.fk/our-home/renewable-energy/.*

« Renewable Energy on the Falkland Islands/Islas Malvinas | The Clean Energy Review ». s. d. Visited July 13, 2020. *https://carlosstjames.com/renewable-energy/renewable-energy-on-the-falkland-islandsislas-malvinas/.*

« SIDS Lighthouses Quickscan: Interim Report ». s. d., 48.

« South America :: Falkland Islands (Islas Malvinas) — The World Factbook - Central Intelligence Agency ». s. d. Visited July 13, 2020. *https://www.cia.gov/library/publications/the-world-factbook/geos/fk.html.*

« The Sea Lion Oil Field Project, Falkland Islands ». s. d. Offshore Technology | Oil and Gas News and Market Analysis. Visited July 13, 2020. *https://www.offshore-technology.com/projects/sealionfield/.*

Vorrath, Sophie. 2019. « Wave Swell Energy Set to Test New Power Generator off King Island ». RenewEconomy (blog). 26 July 2019. https://reneweconomy.com.au/wave-swell-energy-set-to-test-new-power-generator-off-king-island-12735/.

Appendix

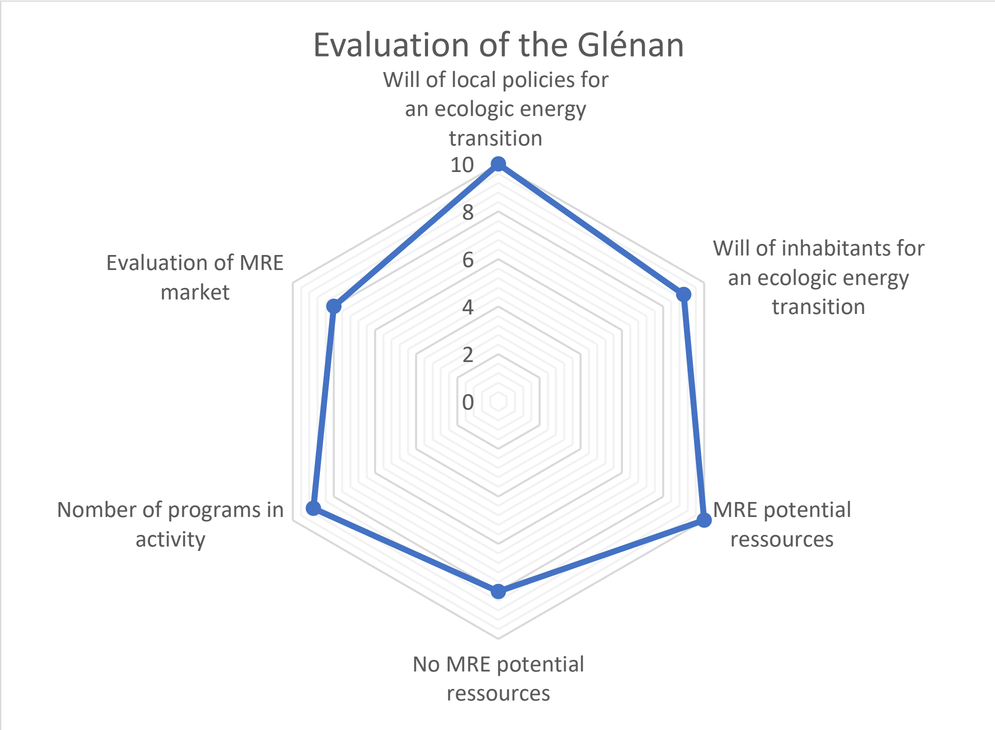
For greater readability of the report, the various figures characterizing the renewable resource potential provided by the institutes listed above are listed below for each island. In addition, the final out of 10 assessment of each island is also presented.

The following table, derived from the evaluation stars, presents the final ranking of all the islands:

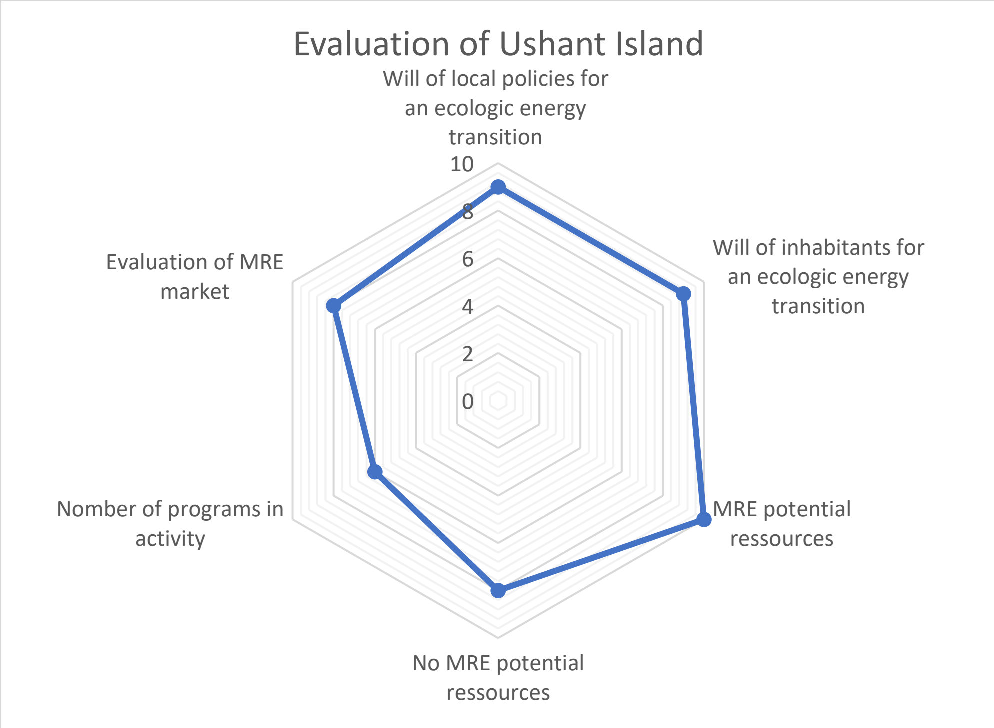
Rank	***Island***	***Note (sur 10)***
1	Sark	9
2	Inishmore	8.3
3	Rathlin Island	8.3
4	Island of Molène	8.3
5	Ushant Island	8.3
6	Chausey	8.2
7	Ile-de-Sein	8.2
8	Aurigny	8
9	Cape clear	7.5
10	Lundy Island	7.2
11	Ventotene	6.8
12	Scilly	6.8
13	Falkland Island	6.3
14	Madère	6.3
15	Raméa	6.1
16	Salina	6
17	Clare	6
18	Les Glénan	6
19	Kythnos	5.8
20	Eigg	5.6

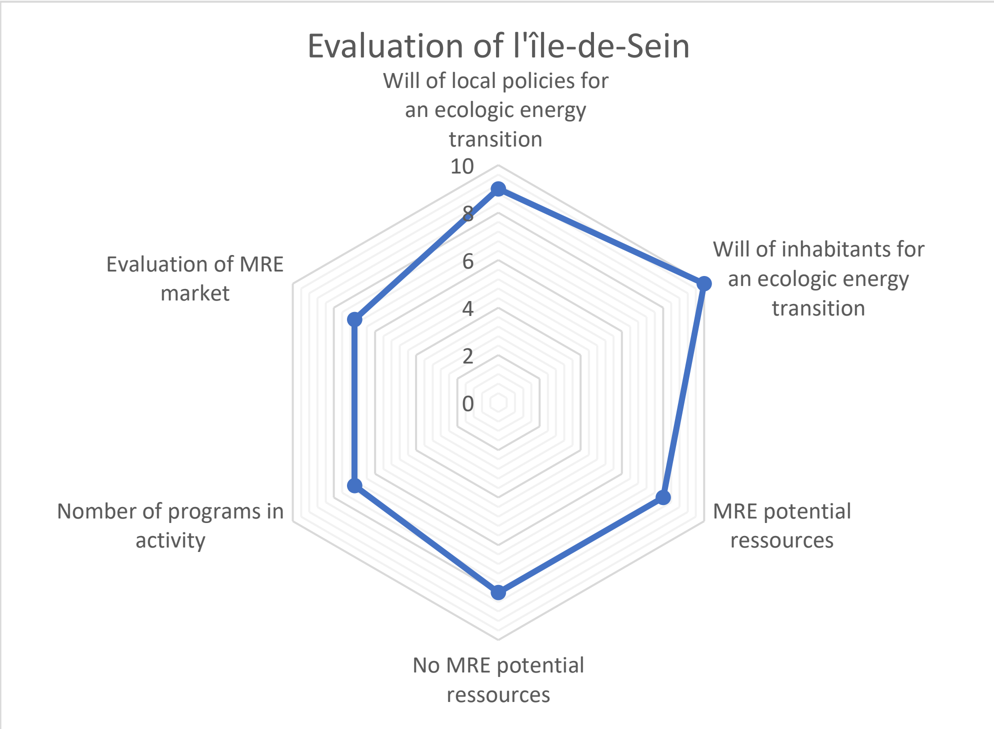
21	Tilos	5.2
22	King Island	5.2
23	Heligoland	5
24	Açores	5

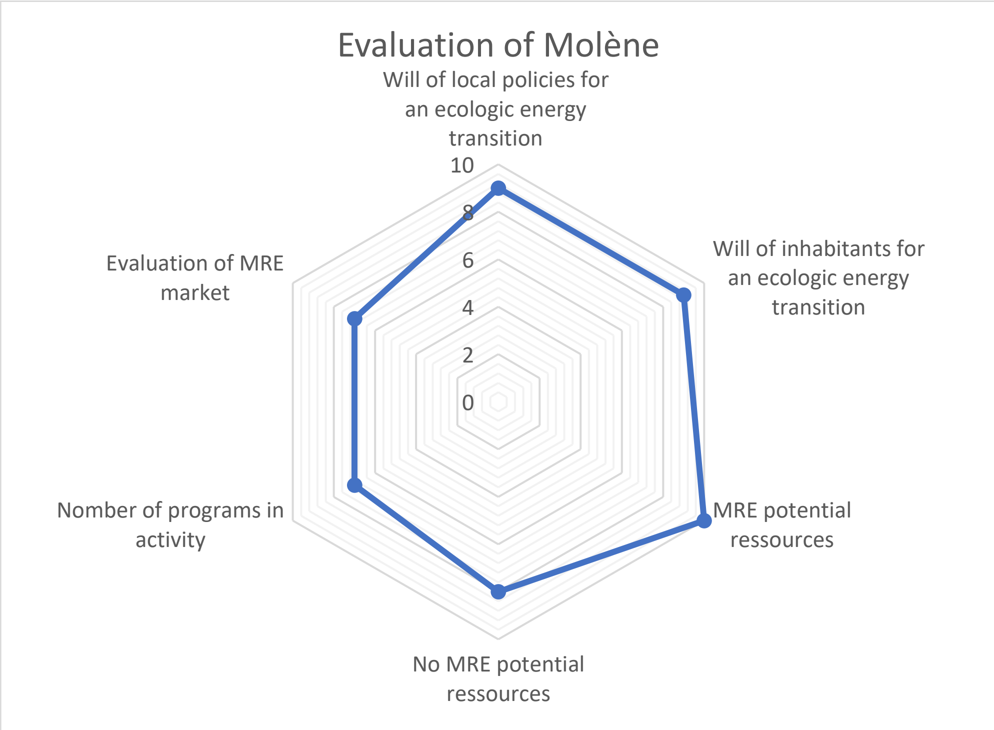
Archipelago of the Glénan :



Ile-de-Sein, Island of Molène and Ushant Island :


Evaluation of Ushant Island
Will of local policies for an ecologic energy transition
10
8
6
4
2
0
Will of inhabitants for an ecologic energy transition
MRE potential ressources
No MRE potential ressources
Nomber of programs in activity
Evaluation of MRE market

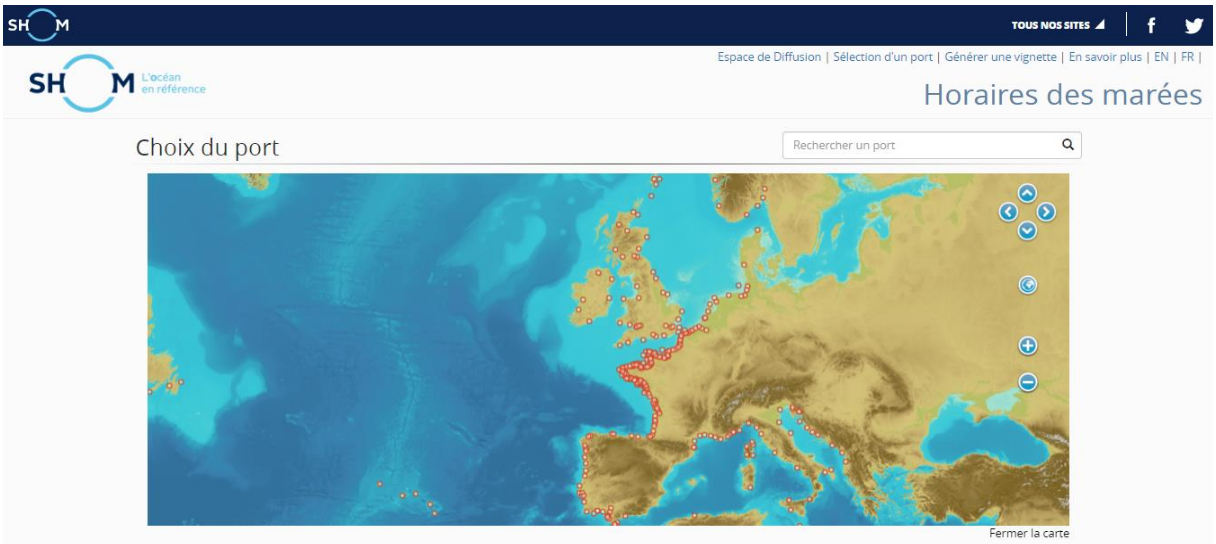

Evaluation of l'île-de-Sein
Will of local policies for an ecologic energy transition
10
8
6
4
2
0
Will of inhabitants for an ecologic energy transition
MRE potential ressources
No MRE potential ressources
Nomber of programs in activity
Evaluation of MRE market

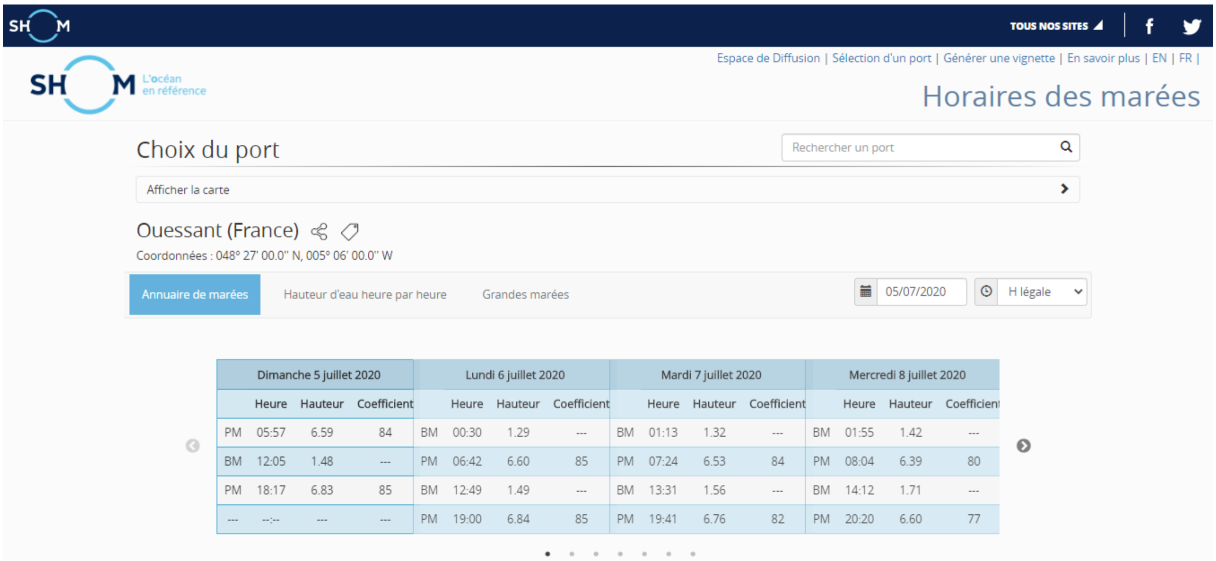


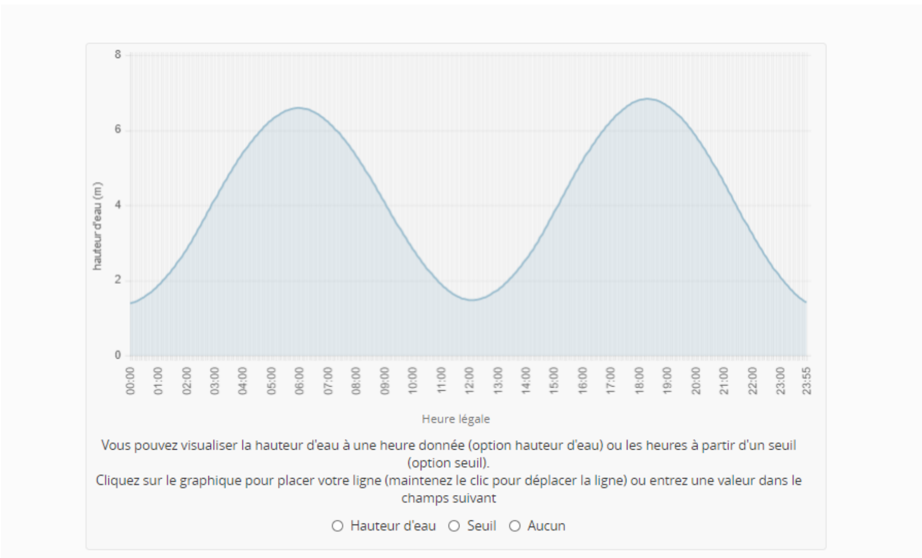
The following figures characterise the island of Ouessant and to a lesser extent the island of Molène in view of their proximity. The figures for Île-de-Sein and the Glénan archipelago are available from the same institutes mentioned earlier in the report.

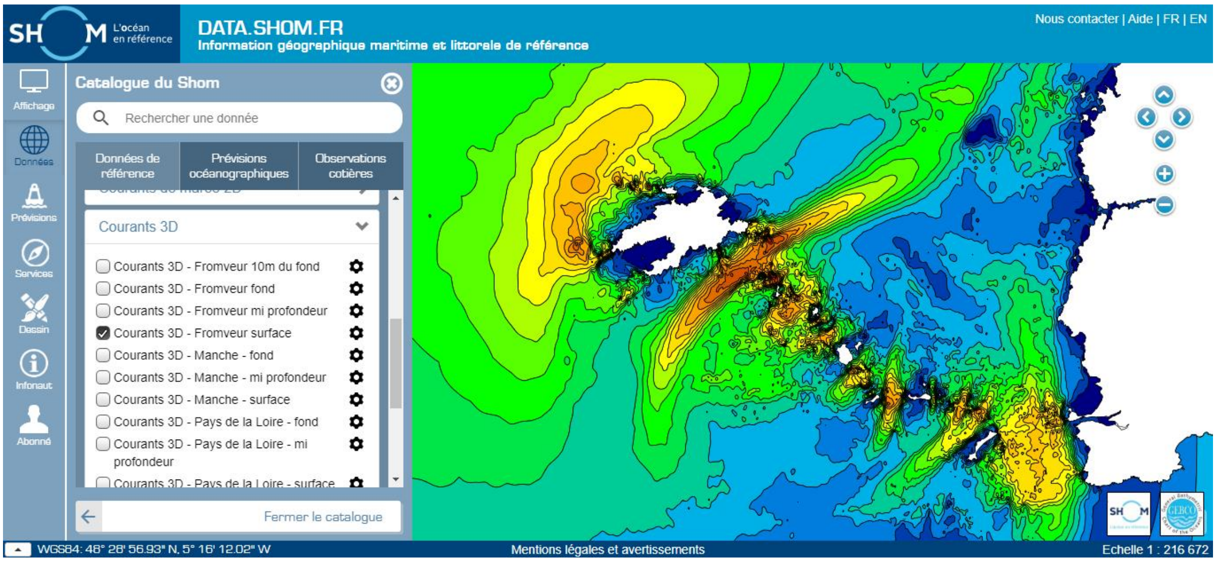
The following figures represent respectively:

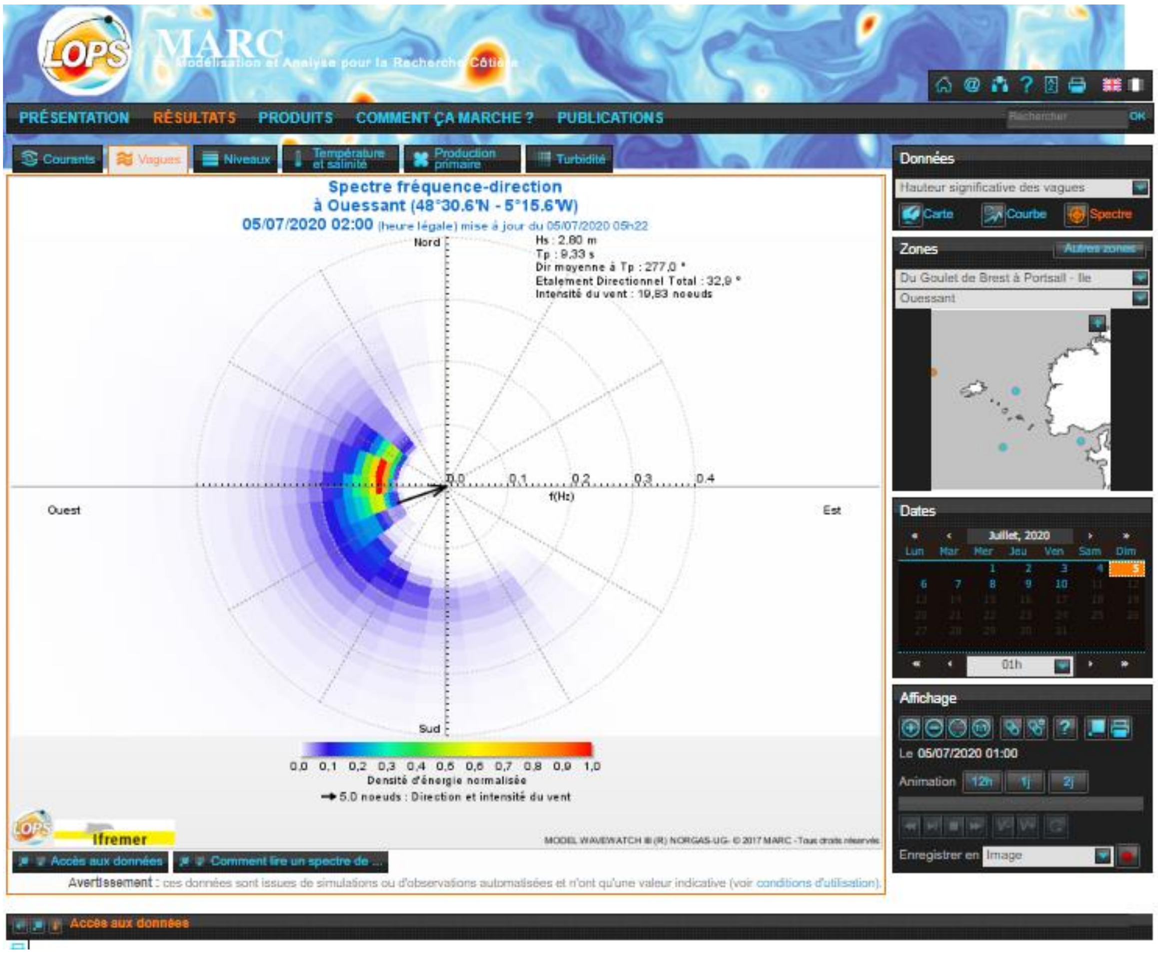
- The ports identified by the SHOM
- The tide schedules for the port of Ushant
- The height of water at Ouessant according to the time of day
- Surface currents in the passage of the Fromveur
- The frequency/direction wave spectrum at Ouessant
- The significant height and the height of the waves at Ouessant
- A compass rose characterizing the wind resource in Ushant

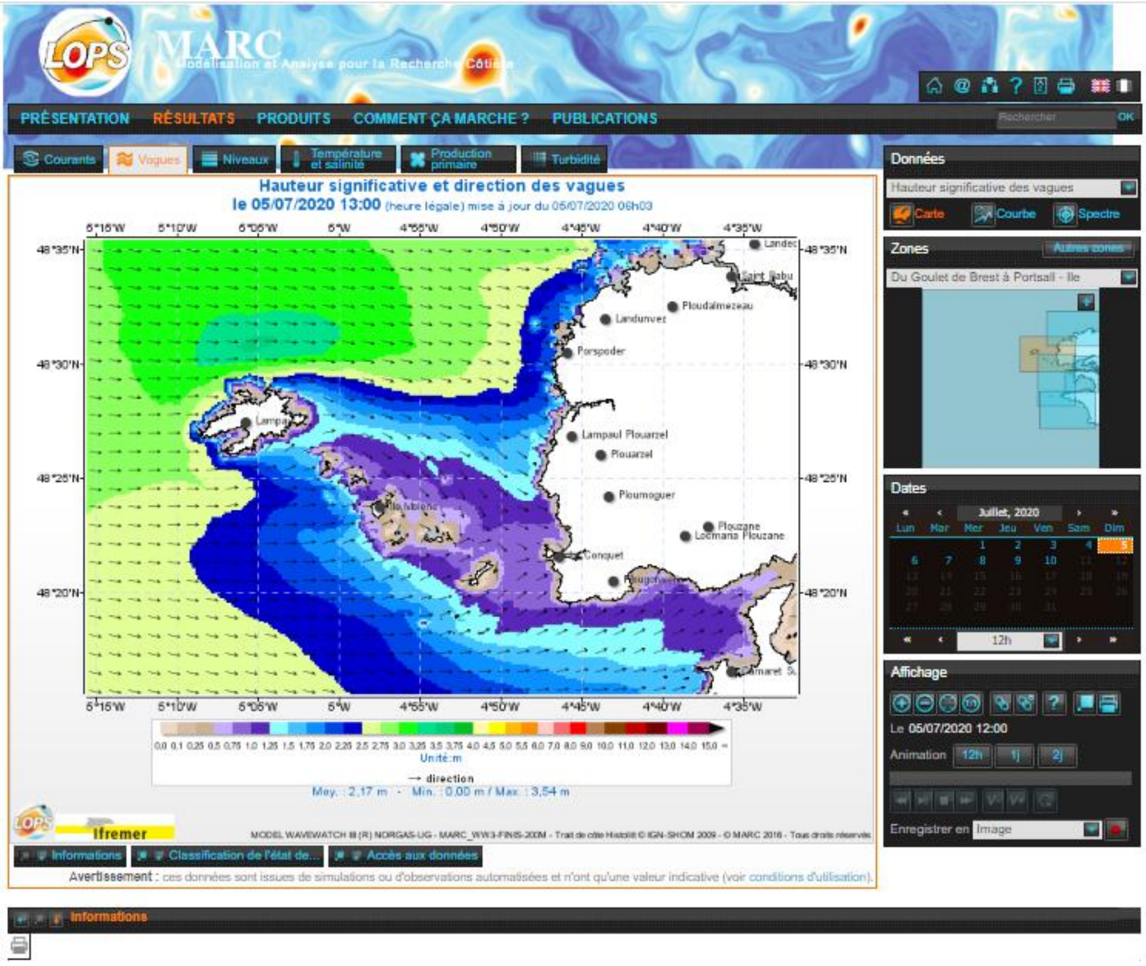

TOUS NOS SITES
Espace de Diffusion | Sélection d'un port | Générer une vignette | En savoir plus | EN | FR |
L'océan en référence
Horaires des marées
Choix du port
Rechercher un port
Fermer la carte

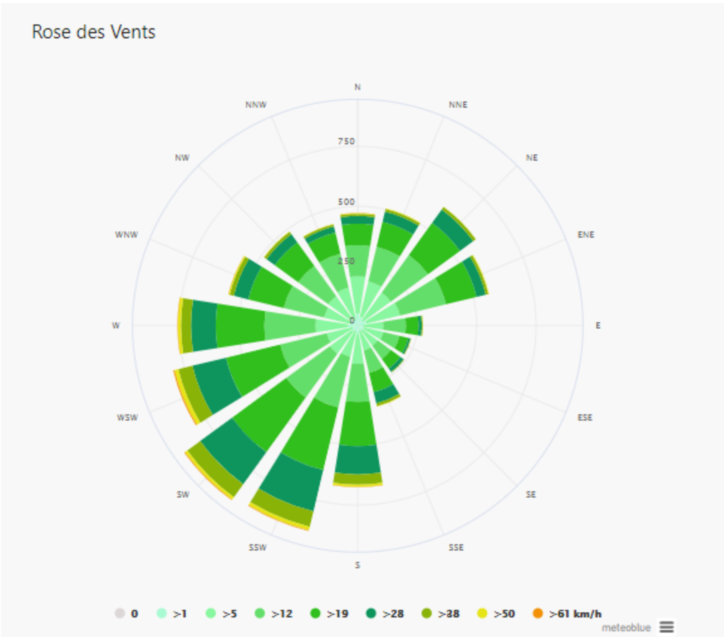

TOUS NOS SITES
Espace de Diffusion | Sélection d'un port | Générer une vignette | En savoir plus | EN | FR |
L'océan en référence
Horaires des marées
Choix du port
Rechercher un port
Afficher la carte
Ouessant (France)
Coordonnées : 048° 27' 00.0'' N, 005° 06' 00.0'' W
Annuaire de marées
Hauteur d'eau heure par heure
Grandes marées
05/07/2020
H légale
Dimanche 5 juillet 2020
Heure Hauteur Coefficient
PM 05:57 6.59 84
BM 12:05 1.48 ---
PM 18:17 6.83 85
--- --:-- --- ---
Lundi 6 juillet 2020
Heure Hauteur Coefficient
BM 00:30 1.29 ---
PM 06:42 6.60 85
BM 12:49 1.49 ---
PM 19:00 6.84 85
Mardi 7 juillet 2020
Heure Hauteur Coefficient
BM 01:13 1.32 ---
PM 07:24 6.53 84
BM 13:31 1.56 ---
PM 19:41 6.76 82
Mercredi 8 juillet 2020
Heure Hauteur Coefficient
BM 01:55 1.42 ---
PM 08:04 6.39 80
BM 14:12 1.71 ---
PM 20:20 6.60 77


8
6
4
2
0
hauteur d'eau (m)
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
23:55
Heure légale
Vous pouvez visualiser la hauteur d'eau à une heure donnée (option hauteur d'eau) ou les heures à partir d'un seuil (option seuil).
Cliquez sur le graphique pour placer votre ligne (maintenez le clic pour déplacer la ligne) ou entrez une valeur dans le champs suivant
Hauteur d'eau
Seuil
Aucun


DATA.SHOM.FR
Information géographique maritime et littorale de référence
Nous contacter | Aide | FR | EN
Catalogue du Shom
Rechercher une donnée
Données de référence
Prévisions océanographiques
Observations côtières
Courants 3D
Courants 3D - Fromveur 10m du fond
Courants 3D - Fromveur fond
Courants 3D - Fromveur mi profondeur
Courants 3D - Fromveur surface
Courants 3D - Manche - fond
Courants 3D - Manche - mi profondeur
Courants 3D - Manche - surface
Courants 3D - Pays de la Loire - fond
Courants 3D - Pays de la Loire - mi profondeur
Fermer le catalogue
WGS84: 48° 28' 56.93" N, 5° 16' 12.02" W
Mentions légales et avertissements
Echelle 1 : 216 672

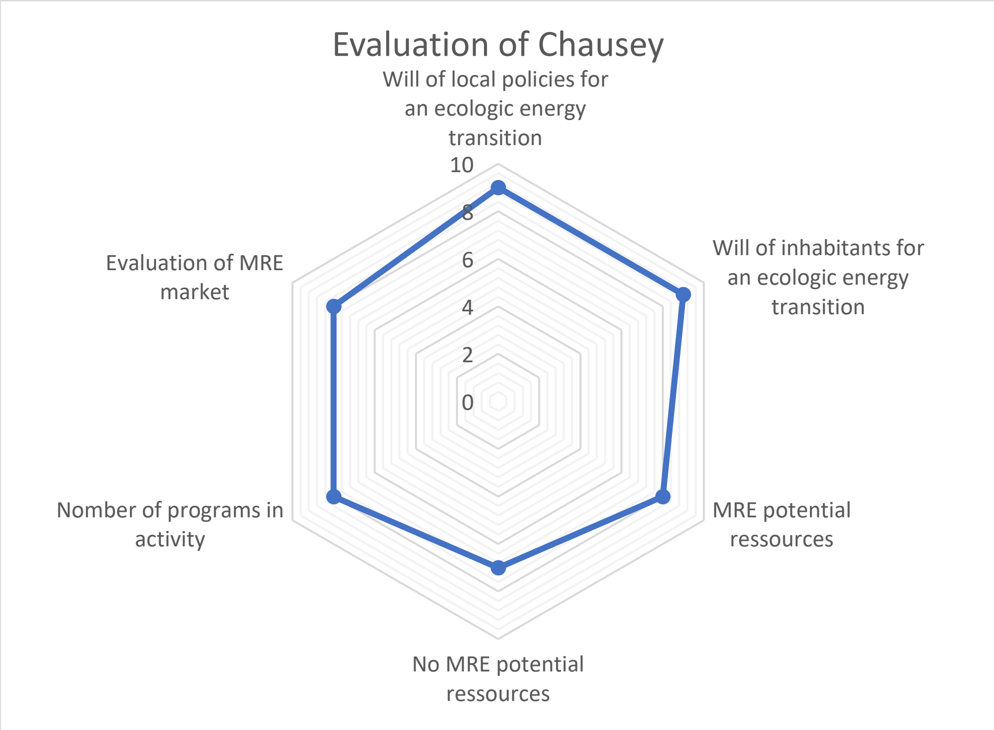

MARC
PRÉSENTATION RÉSULTATS PRODUITS COMMENT ÇA MARCHE ? PUBLICATIONS
Courants Vagues Niveaux Température et salinité Production primaire Turbidité
Spectre fréquence-direction
à Ouessant (48°30.6'N - 5°15.6'W)
05/07/2020 02:00 (heure légale) mise à jour du 05/07/2020 05h22
Hs : 2.80 m
Tp : 9.33 s
Dir moyenne à Tp : 277.0 °
Etalement Directionnel Total : 32.9 °
Intensité du vent : 10.83 noeuds
Nord
Sud
Ouest
Est
f(Hz)
Densité d'énergie normalisée
5.0 noeuds : Direction et intensité du vent
Données
Hauteur significative des vagues
Carte Courbe Spectre
Zones
Du Goulet de Brest à Portsall - Ile
Ouessant
Dates
Juillet, 2020
Affichage
Le 05/07/2020 01:00
Animation
Enregistrer en Image
Accès aux données
Avertissement : ces données sont issues de simulations ou d'observations automatisées et n'ont qu'une valeur indicative (voir conditions d'utilisation).





La Rose des Vents pour Ouessant montre combien d'heures par an le vent souffle dans la direction indiquée. Exemple SO: Le vent souffle du sud-ouest (SO) au nord-est (NE). Cap Horn, le point de la terre plus au sud en Amérique du Sud, dispose d'un fort vent de l'Ouest caractéristique, qui produit des traversées d'est en ouest très difficiles, surtout pour les voiliers.

Chausey archipelago:

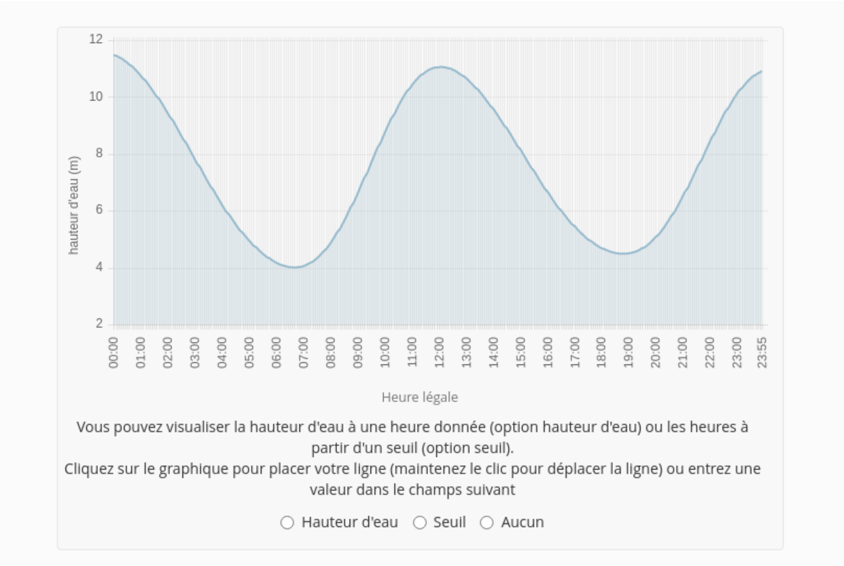


Iles Chausey (France)

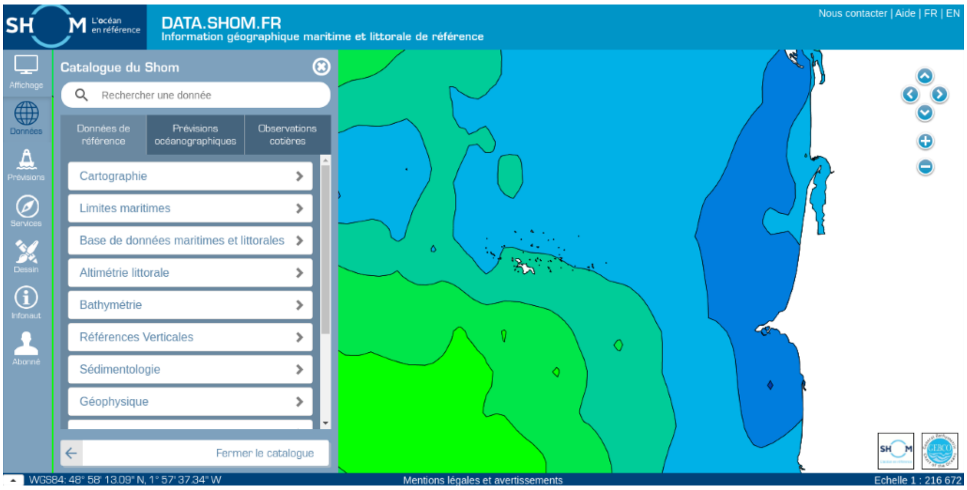
Coordonnées : 048° 52' 00.0" N, 001° 49' 00.0" W

Annuaire de marées | Hauteur d'eau heure par heure | Grandes marées | 11/07/2020 | H légale

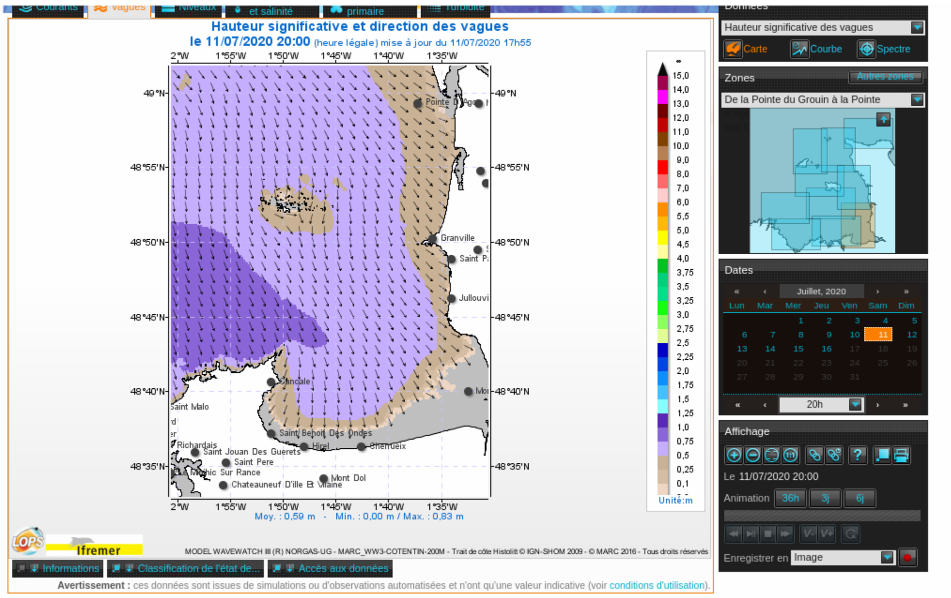
Samedi 11 juillet 2020				Dimanche 12 juillet 2020				Lundi 13 juillet 2020			
	Heure	Hauteur	Coefficient		Heure	Hauteur	Coefficient		Heure	Hauteur	Coefficient
BM	06:39	3.75	---	PM	00:18	10.74	53	PM	00:57	10.24	45
PM	12:04	10.81	57	BM	07:12	4.22	---	BM	07:50	4.62	---
BM	18:47	4.24	---	PM	12:39	10.36	49	PM	13:21	9.97	42
---	--:--	---	---	BM	19:22	4.67	---	BM	20:08	5.03	---



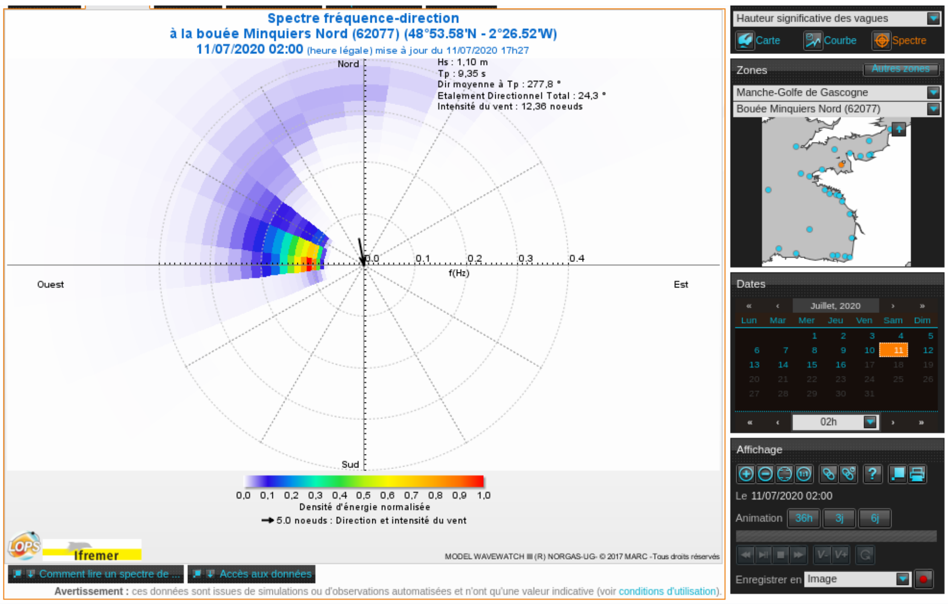
12
10
8
6
4
2
hauteur d'eau (m)
00:00 01:00 02:00 03:00 04:00 05:00 06:00 07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 23:55
Heure légale
Vous pouvez visualiser la hauteur d'eau à une heure donnée (option hauteur d'eau) ou les heures à partir d'un seuil (option seuil).
Cliquez sur le graphique pour placer votre ligne (maintenez le clic pour déplacer la ligne) ou entrez une valeur dans le champs suivant
Hauteur d'eau
Seuil
Aucun



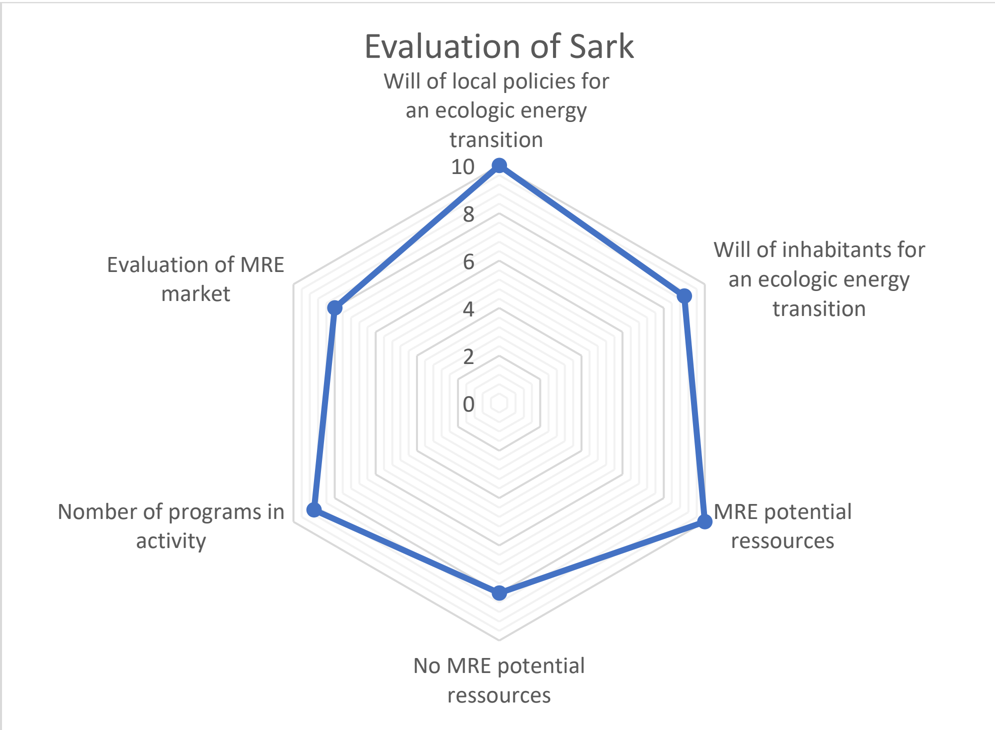
SHOM L'océan en référence
DATA.SHOM.FR
Information géographique maritime et littorale de référence
Nous contacter | Aide | FR | EN
Affichage
Données
Prévisions
Services
Dessin
Infonaut
Abonné
Catalogue du Shom
Rechercher une donnée
Données de référence
Prévisions océanographiques
Observations côtières
Cartographie
Limites maritimes
Base de données maritimes et littorales
Altimétrie littorale
Bathymétrie
Références Verticales
Sédimentologie
Géophysique
Fermer le catalogue
WGS84: 48° 58' 13.09" N, 1° 57' 37.34" W
Mentions légales et avertissements
Echelle 1 : 216 672



Hauteur significative et direction des vagues
le 11/07/2020 20:00 (heure légale) mise à jour du 11/07/2020 17h55
Granville
Saint Malo
Moy. : 0,59 m - Min. : 0,00 m / Max. : 0,83 m
Unité : m
Ifremer
MODEL WAVEWATCH III (R) NORGAS-UG - MARC_WW3-COTENTIN-200M - Trait de côte Histolitt © IGN-SHOM 2009 - © MARC 2016 - Tous droits réservés
Informations
Classification de l'état de...
Accès aux données
Avertissement : ces données sont issues de simulations ou d'observations automatisées et n'ont qu'une valeur indicative (voir conditions d'utilisation).
Hauteur significative des vagues
Carte
Courbe
Spectre
Zones
Autres zones
De la Pointe du Grouin à la Pointe
Dates
Juillet, 2020
Lun Mar Mer Jeu Ven Sam Dim
20h
Affichage
Le 11/07/2020 20:00
Animation 36h 3j 6j
Enregistrer en Image


Spectre fréquence-direction
à la bouée Minquiers Nord (62077) (48°53.58'N - 2°26.52'W)
11/07/2020 02:00 (heure légale) mise à jour du 11/07/2020 17h27
Hs : 1,10 m
Tp : 9,35 s
Dir moyenne à Tp : 277,8 °
Etalement Directionnel Total : 24,3 °
Intensité du vent : 12,36 noeuds
Nord
Ouest
Est
Sud
f(Hz)
0,0 0,1 0,2 0,3 0,4 0,5 0,6 0,7 0,8 0,9 1,0
Densité d'énergie normalisée
5.0 noeuds : Direction et intensité du vent
Ifremer
MODEL WAVEWATCH III (R) NORGAS-UG- © 2017 MARC -Tous droits réservés
Comment lire un spectre de ...
Accès aux données
Avertissement : ces données sont issues de simulations ou d'observations automatisées et n'ont qu'une valeur indicative (voir conditions d'utilisation).
Hauteur significative des vagues
Carte
Courbe
Spectre
Zones
Autres zones
Manche-Golfe de Gascogne
Bouée Minquiers Nord (62077)
Dates
Juillet, 2020
Lun Mar Mer Jeu Ven Sam Dim
02h
Affichage
Le 11/07/2020 02:00
Animation 36h 3j 6j
Enregistrer en Image

Sark:

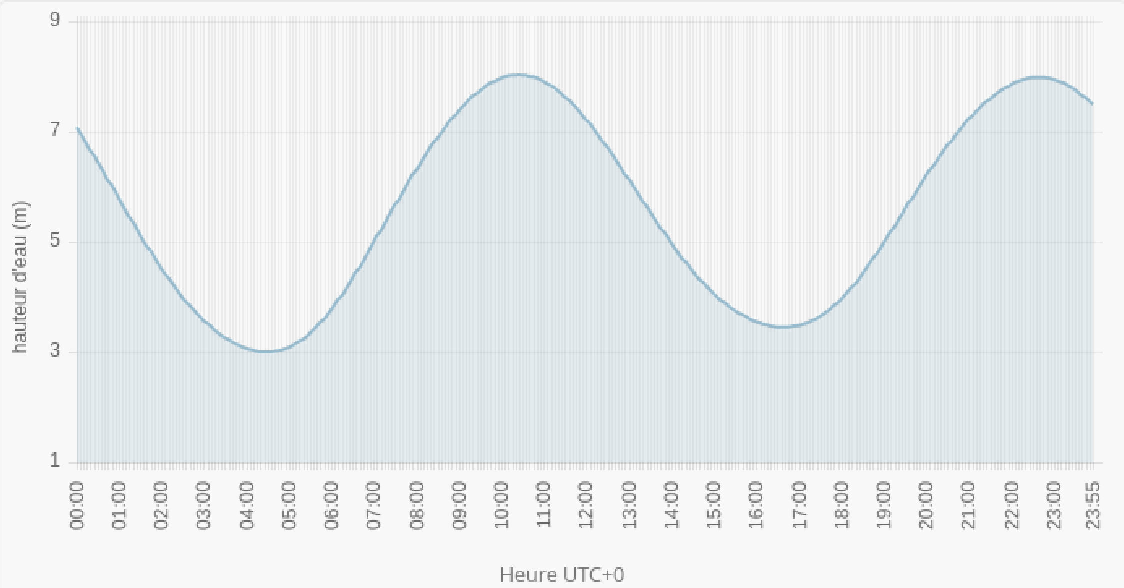

Evaluation of Sark
Will of local policies for an ecologic energy transition
Will of inhabitants for an ecologic energy transition
MRE potential ressources
No MRE potential ressources
Nomber of programs in activity
Evaluation of MRE market
10
8
6
4
2
0

St-Peter Port (Guernesey)

Coordonnées : 049° 27' 00.0'' N, 002° 31' 00.0'' W

Annuaire de marées | Hauteur d'eau heure par heure | 11/07/2020 | UTC +0

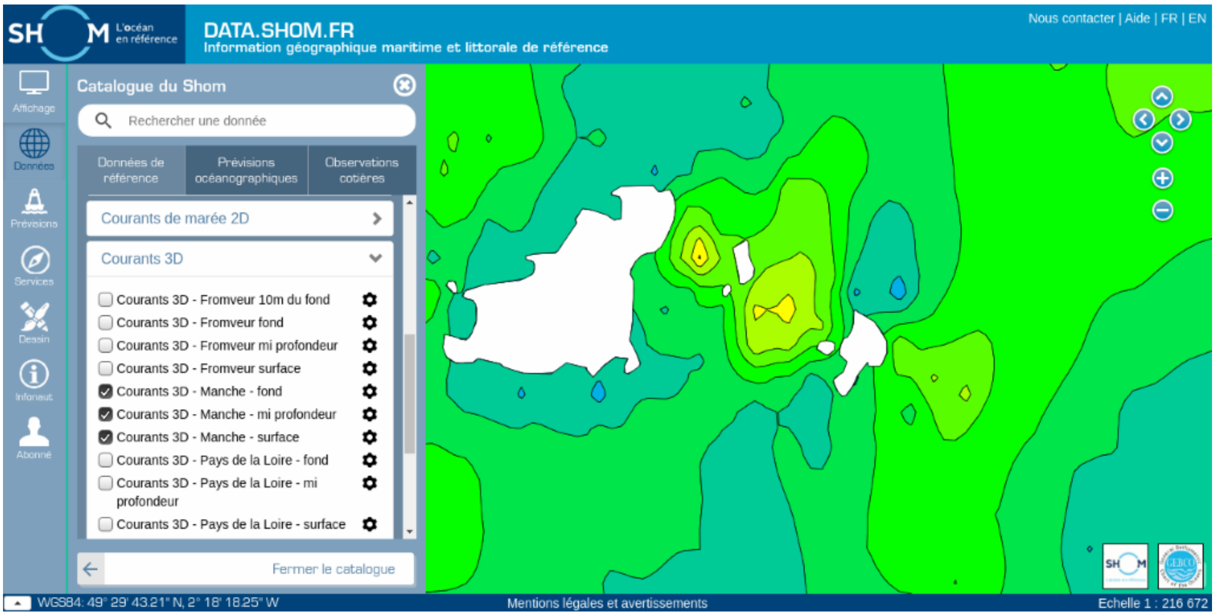
Samedi 11 juillet 2020				Dimanche 12 juillet 2020				Lundi 13 juillet 2020			
	Heure	Hauteur	Coefficient		Heure	Hauteur	Coefficient		Heure	Hauteur	Coefficient
BM	04:29	2.61	---	BM	05:07	3.03	---	BM	05:53	3.38	---
PM	10:24	7.64	---	PM	11:03	7.27	---	PM	11:50	6.98	---
BM	16:38	3.06	---	BM	17:19	3.45	---	BM	18:12	3.74	---
PM	22:38	7.59	---	PM	23:21	7.19	---	---	--:--	---	---

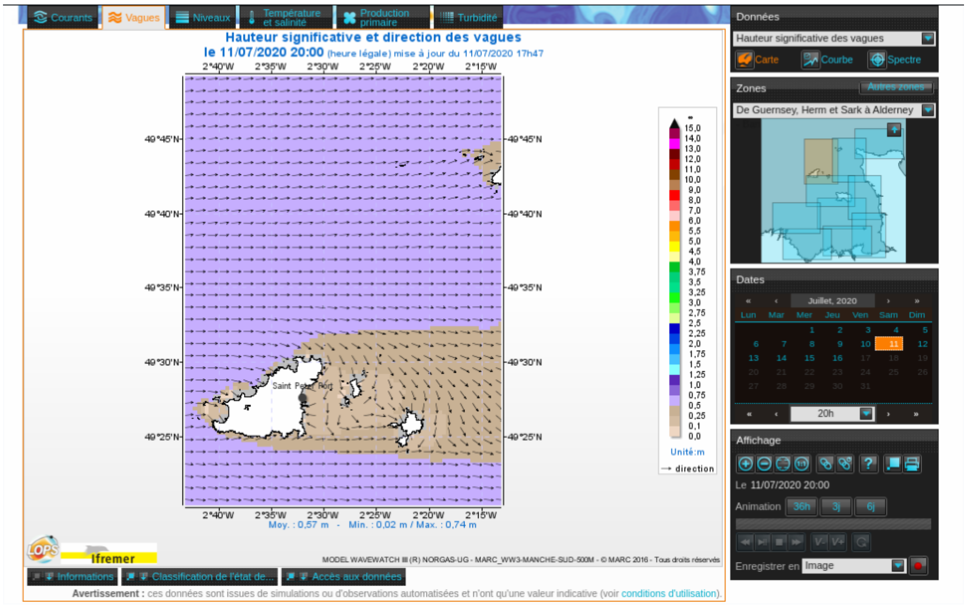


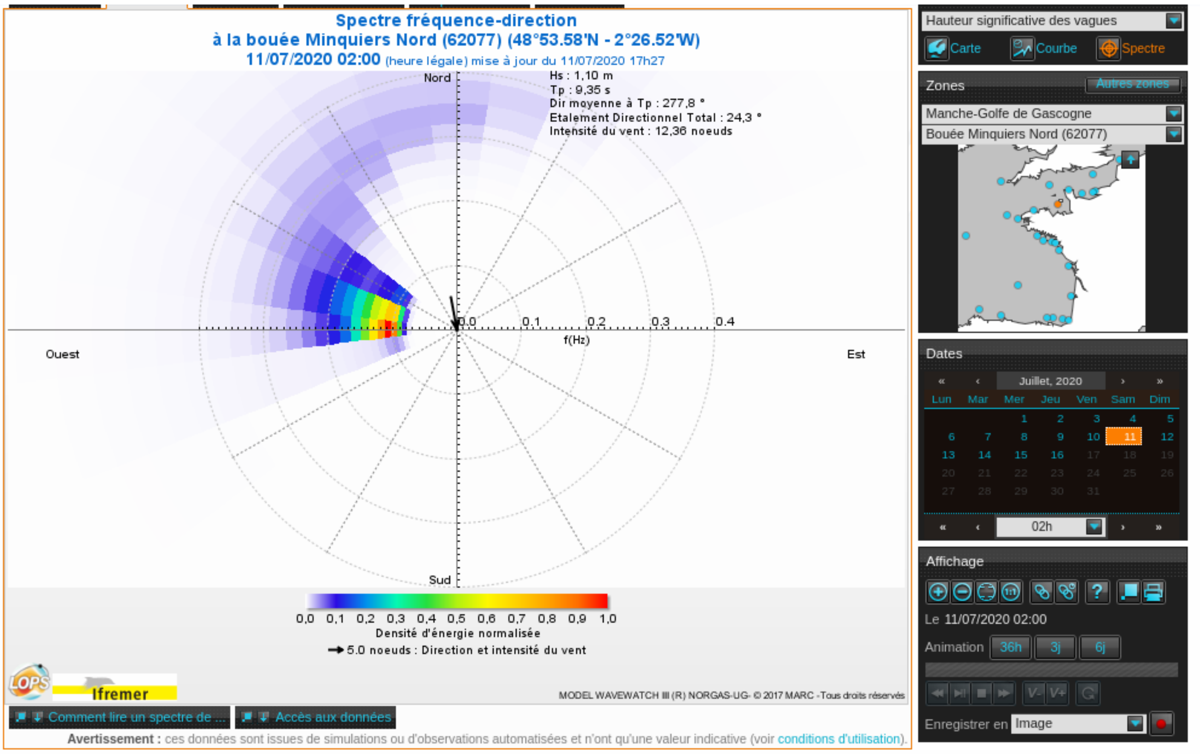
Vous pouvez visualiser la hauteur d'eau à une heure donnée (option hauteur d'eau) ou les heures à partir d'un seuil (option seuil).

Cliquez sur le graphique pour placer votre ligne (maintenez le clic pour déplacer la ligne) ou entrez une valeur dans le champs suivant

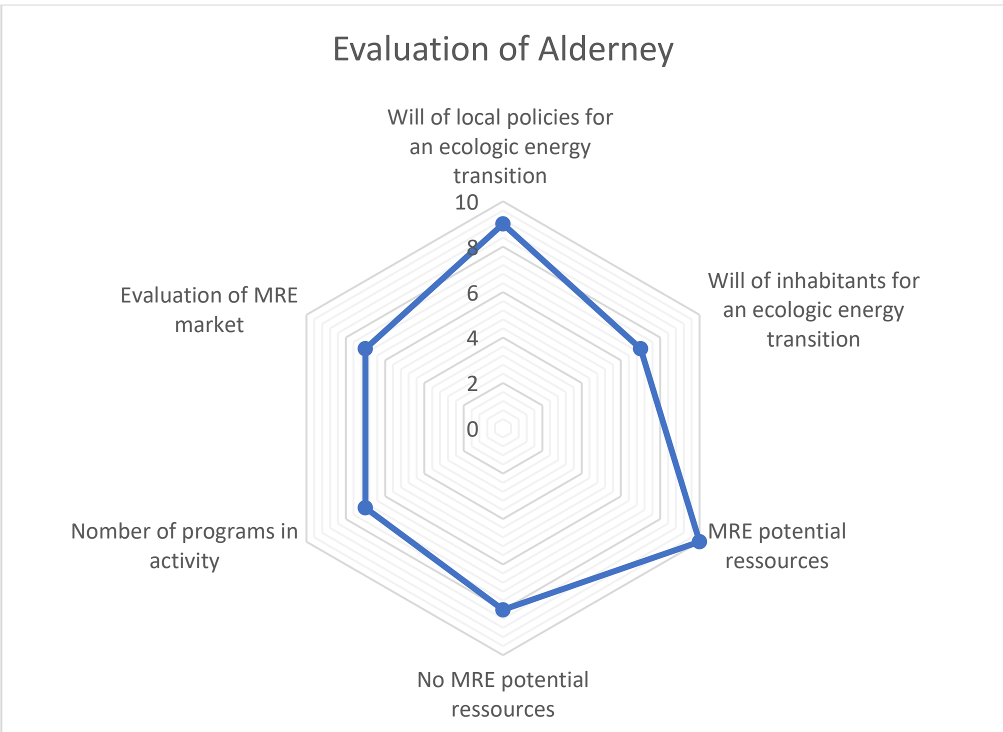
○ Hauteur d'eau ○ Seuil ○ Aucun


L'océan en référence
DATA.SHOM.FR
Information géographique maritime et littorale de référence
Nous contacter | Aide | FR | EN
Catalogue du Shom
Rechercher une donnée
Données de référence
Prévisions océanographiques
Observations côtières
Courants de marée 2D
Courants 3D
Courants 3D - Fromveur 10m du fond
Courants 3D - Fromveur fond
Courants 3D - Fromveur mi profondeur
Courants 3D - Fromveur surface
Courants 3D - Manche - fond
Courants 3D - Manche - mi profondeur
Courants 3D - Manche - surface
Courants 3D - Pays de la Loire - fond
Courants 3D - Pays de la Loire - mi profondeur
Courants 3D - Pays de la Loire - surface
Fermer le catalogue
Affichage
Données
Prévisions
Services
Dessin
Infonaut
Abonné
WGS84: 49° 29' 43.21" N, 2° 18' 18.25" W
Mentions légales et avertissements
Echelle 1 : 216 672

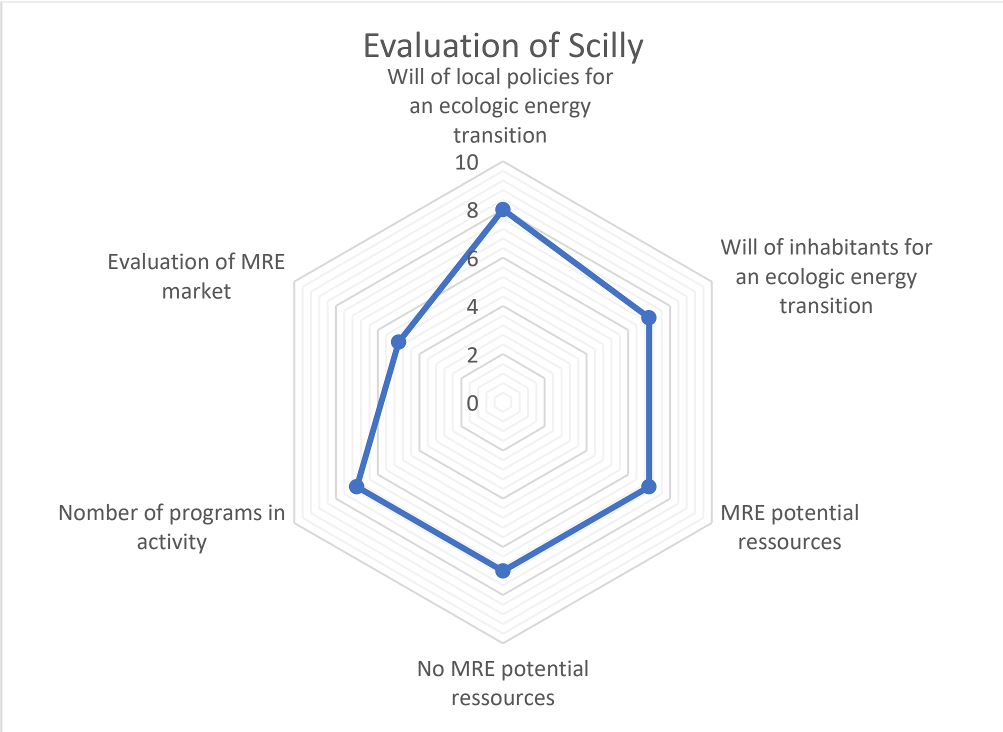

Courants
Vagues
Niveaux
Température et salinité
Production primaire
Turbidité
Hauteur significative et direction des vagues
le 11/07/2020 20:00 (heure légale) mise à jour du 11/07/2020 17h47
Moy. : 0,57 m - Min. : 0,02 m / Max. : 0,74 m
Unité : m
direction
Ifremer
MODEL WAVEWATCH III (R) NORGAS-UG - MARC_WW3-MANCHE-SUD-500M - © MARC 2016 - Tous droits réservés
Informations
Classification de l'état de...
Accès aux données
Avertissement : ces données sont issues de simulations ou d'observations automatisées et n'ont qu'une valeur indicative (voir conditions d'utilisation).
Données
Hauteur significative des vagues
Carte
Courbe
Spectre
Zones
Autres zones
De Guernsey, Herm et Sark à Alderney
Dates
Juillet, 2020
Affichage
Le 11/07/2020 20:00
Animation
Enregistrer en
Image


Spectre fréquence-direction
à la bouée Minquiers Nord (62077) (48°53.58'N - 2°26.52'W)
11/07/2020 02:00 (heure légale) mise à jour du 11/07/2020 17h27
Hs : 1,10 m
Tp : 9,35 s
Dir moyenne à Tp : 277,8 °
Etalement Directionnel Total : 24,3 °
Intensité du vent : 12,36 noeuds
Nord
Ouest
Est
Sud
f(Hz)
Densité d'énergie normalisée
5.0 noeuds : Direction et intensité du vent
Ifremer
MODEL WAVEWATCH III (R) NORGAS-UG- © 2017 MARC -Tous droits réservés
Comment lire un spectre de ...
Accès aux données
Avertissement : ces données sont issues de simulations ou d'observations automatisées et n'ont qu'une valeur indicative (voir conditions d'utilisation).
Hauteur significative des vagues
Carte
Courbe
Spectre
Zones
Autres zones
Manche-Golfe de Gascogne
Bouée Minquiers Nord (62077)
Dates
Juillet, 2020
Lun Mar Mer Jeu Ven Sam Dim
02h
Affichage
Le 11/07/2020 02:00
Animation 36h 3j 6j
Enregistrer en Image

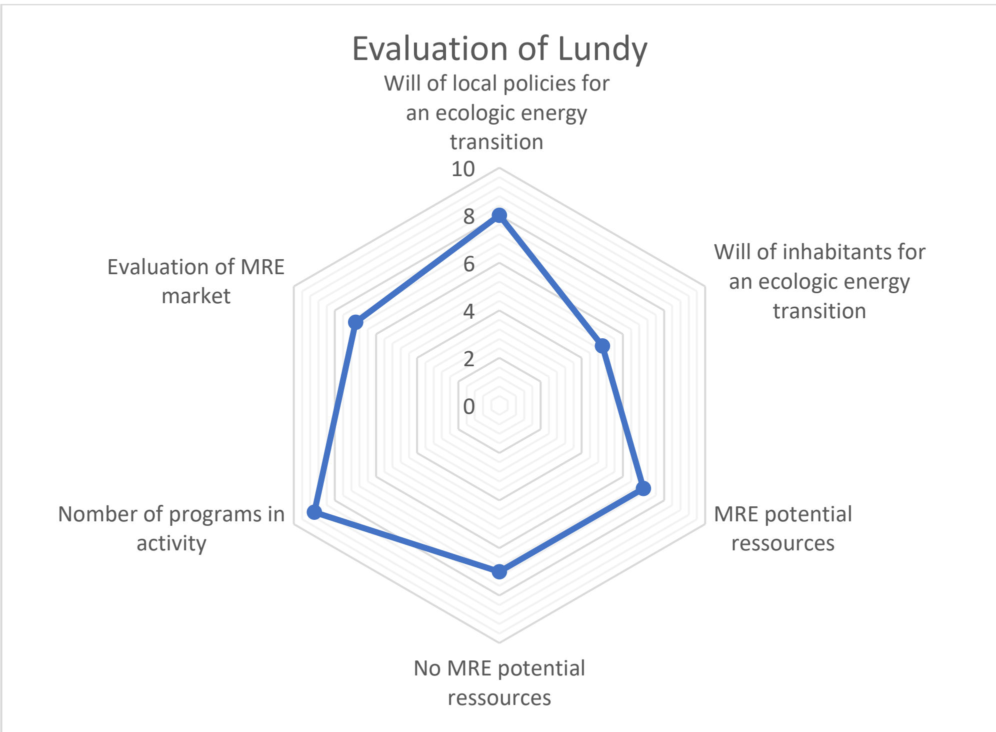
Alderney:


Evaluation of Alderney
Will of local policies for an ecologic energy transition
Will of inhabitants for an ecologic energy transition
MRE potential ressources
No MRE potential ressources
Nomber of programs in activity
Evaluation of MRE market
10
8
6
4
2
0

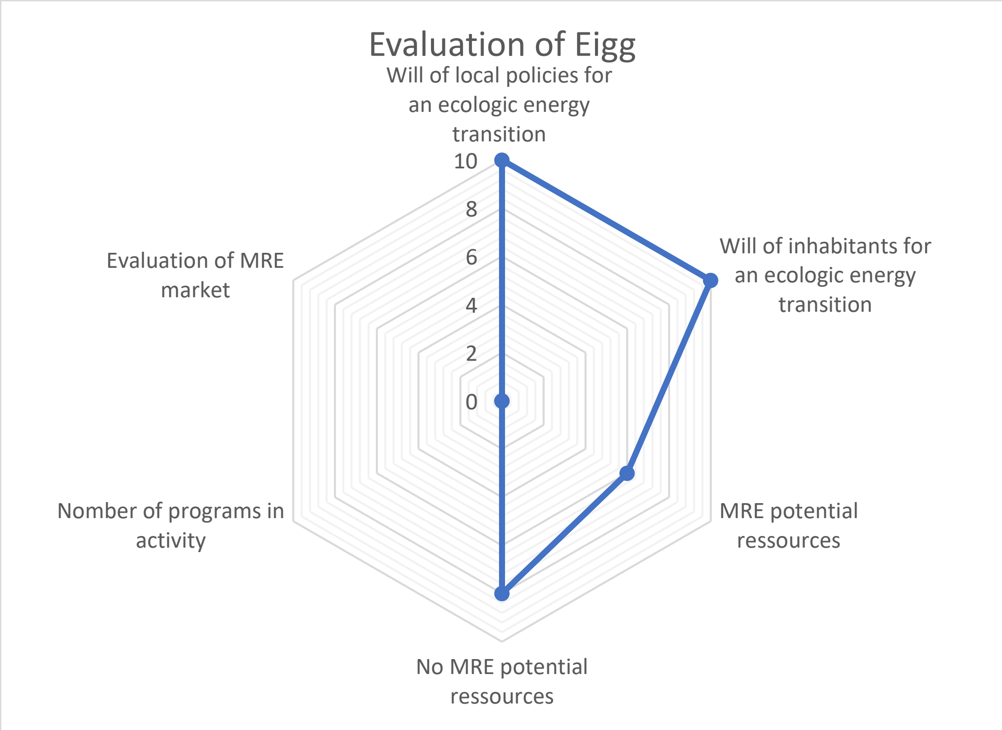
Scilly:



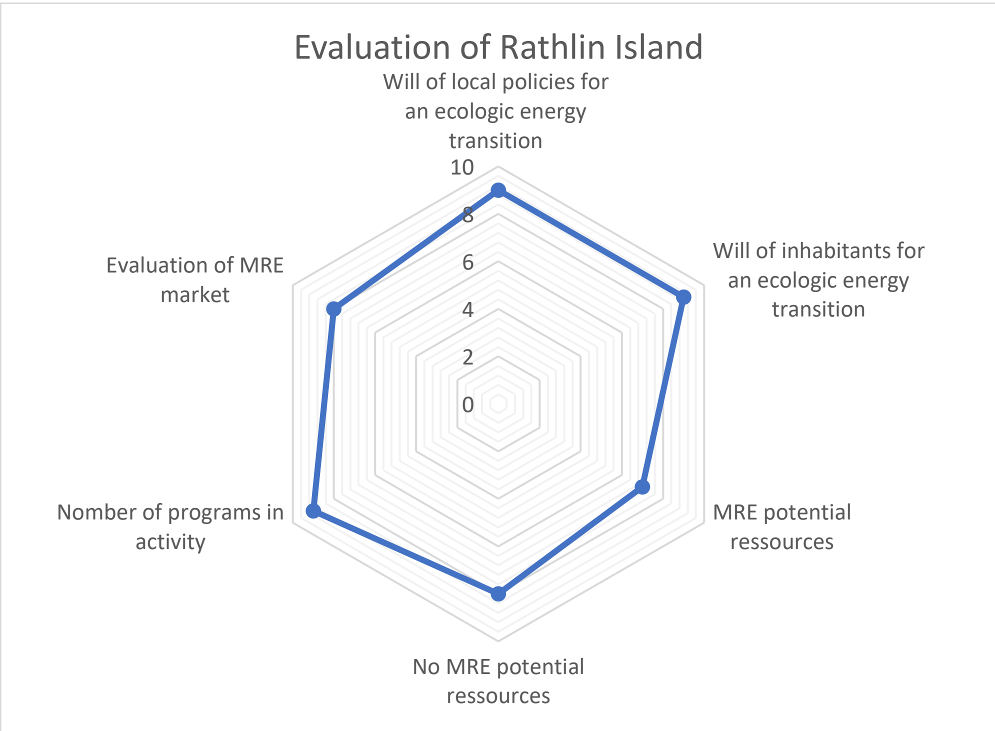
Lundy Island:



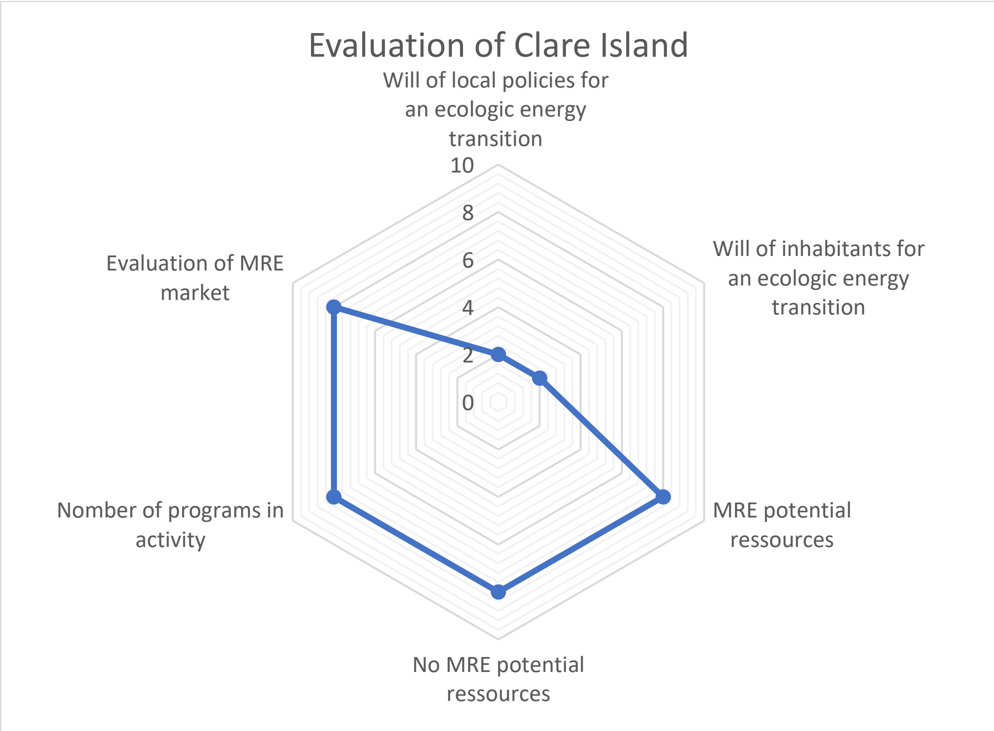
Eigg Island:

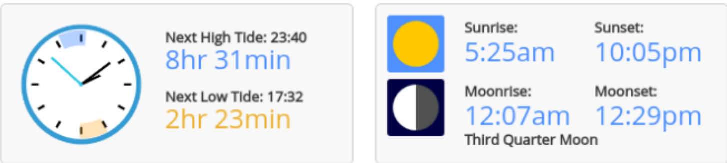


Rathlin Island:



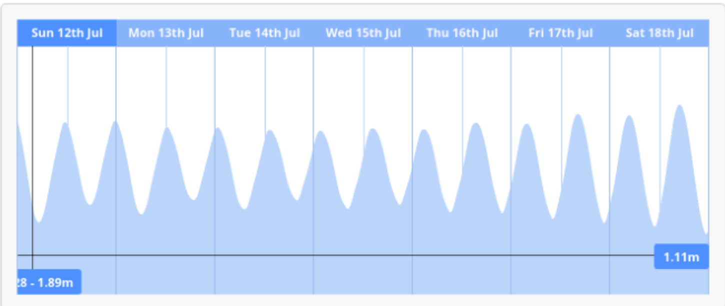
Clare Island:





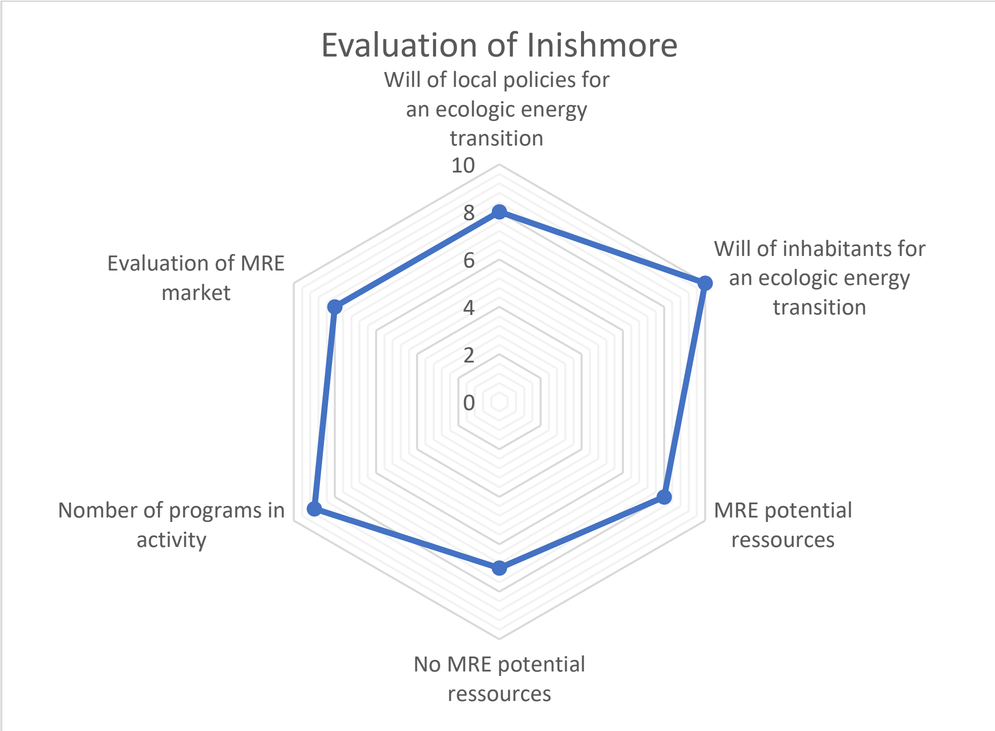
Clare Island Tide Graphs

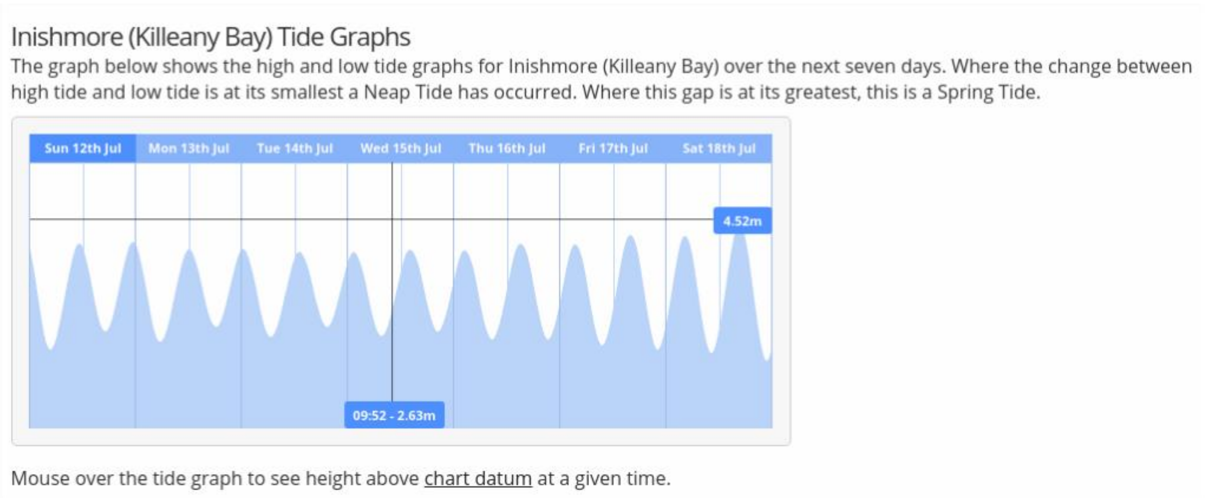
The graph below shows the high and low tide graphs for Clare Island over the next seven days. Where the change between high tide and low tide is at its smallest a Neap Tide has occurred. Where this gap is at its greatest, this is a Spring Tide.



Mouse over the tide graph to see height above chart datum at a given time.

Inishmore:

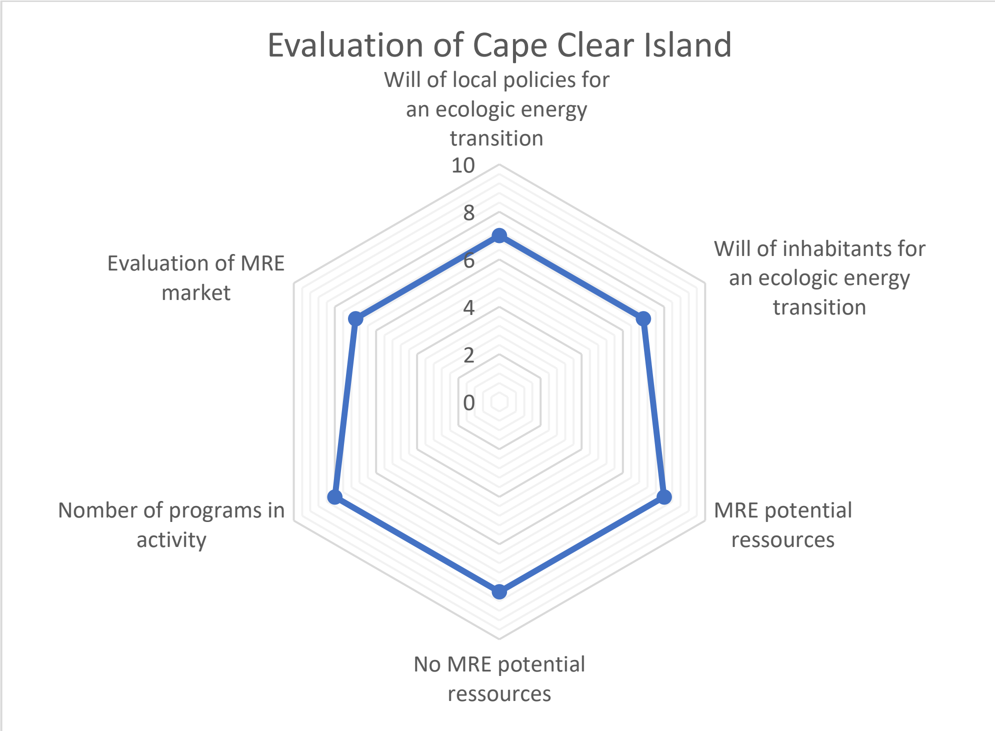



Inishmore (Killeany Bay) Tide Graphs

The graph below shows the high and low tide graphs for Inishmore (Killeany Bay) over the next seven days. Where the change between high tide and low tide is at its smallest a Neap Tide has occurred. Where this gap is at its greatest, this is a Spring Tide.

Mouse over the tide graph to see height above chart datum at a given time.

Cape Clear Island:

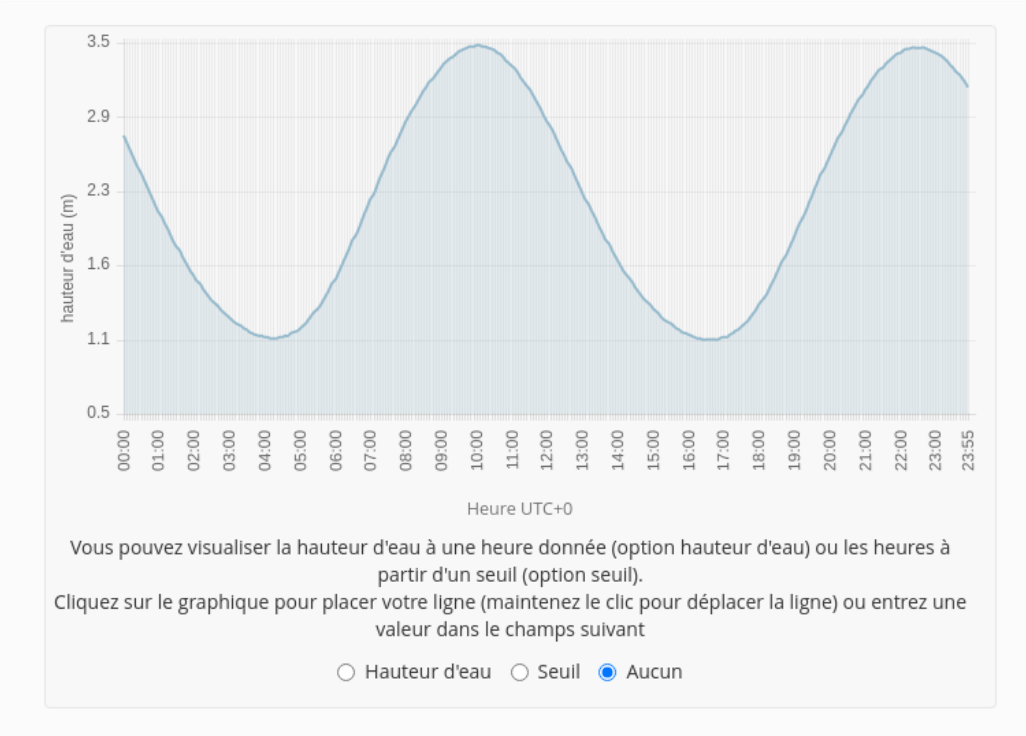


Cobh (Irlande)

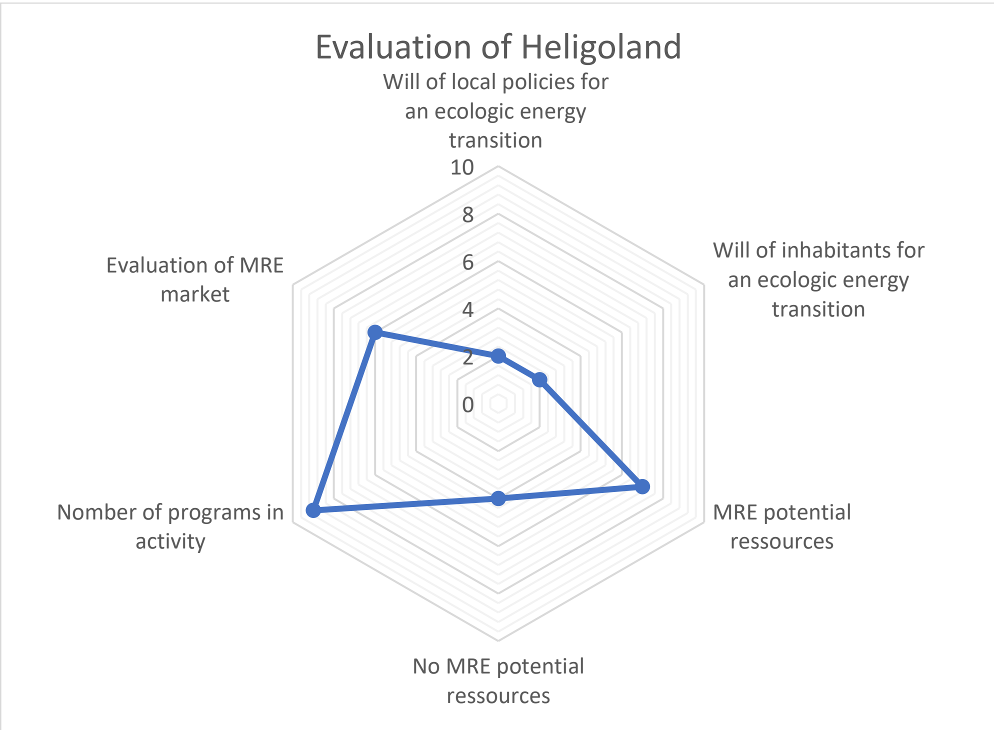
Coordonnées : 051° 51' 00.0" N, 008° 18' 00.0" W

Annuaire de marées | Hauteur d'eau heure par heure | 12/07/2020 | UTC +0

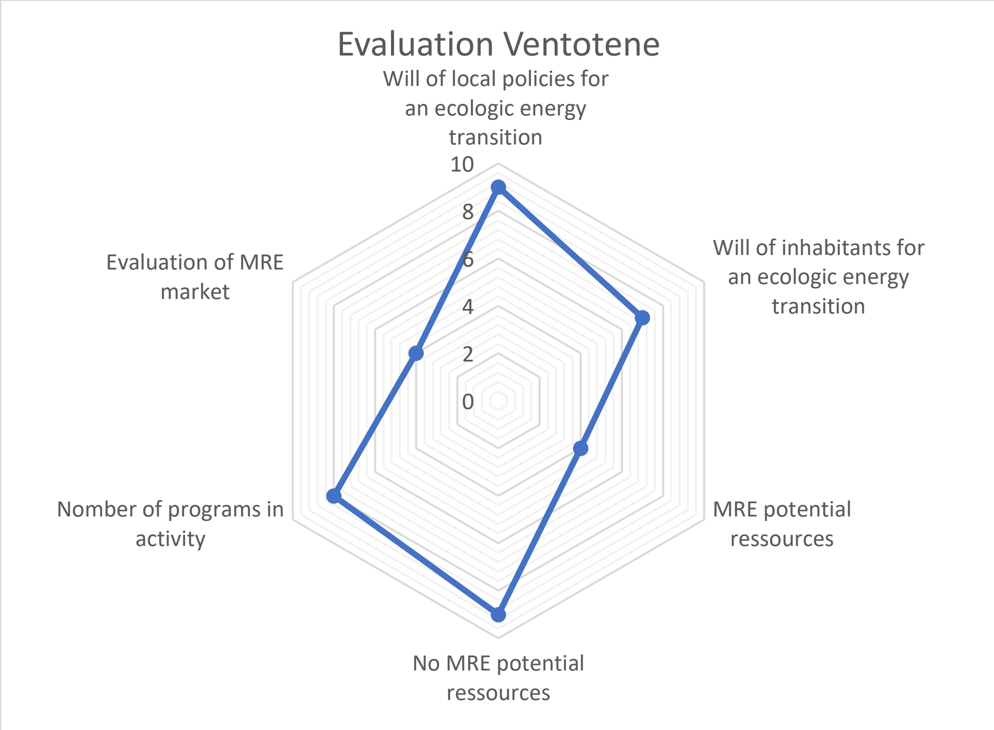
Dimanche 12 juillet 2020				Lundi 13 juillet 2020				Mardi 14 juillet 2020			
	Heure	Hauteur	Coefficient		Heure	Hauteur	Coefficient		Heure	Hauteur	Coefficient
BM	04:15	1.06	---	BM	05:04	1.16	---	BM	05:59	1.23	---
PM	10:01	3.43	---	PM	10:49	3.35	---	PM	11:43	3.29	---
BM	16:37	1.05	---	BM	17:29	1.16	---	BM	18:28	1.22	---
PM	22:29	3.41	---	PM	23:20	3.34	---	---	--:--	---	---



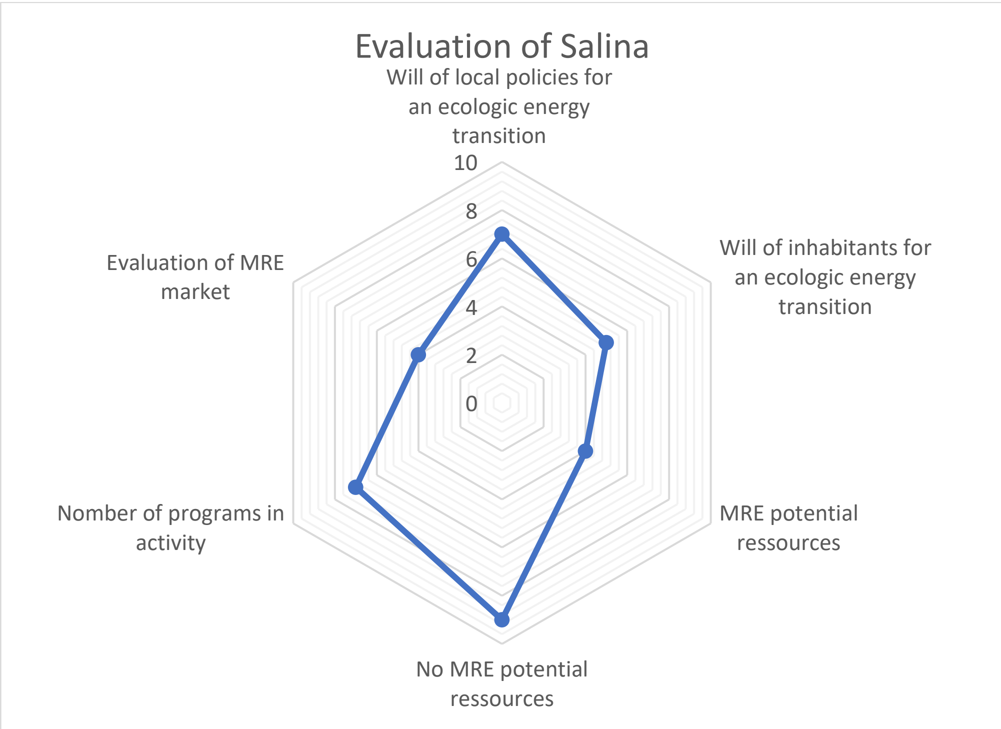
Heligoland:



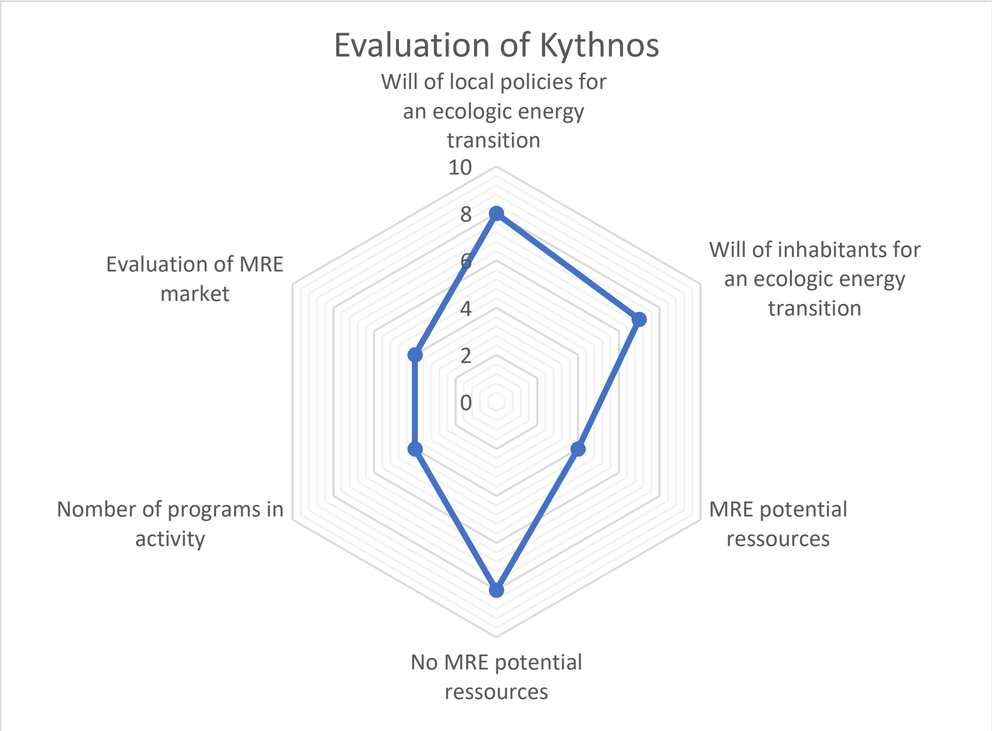
Ventotene:



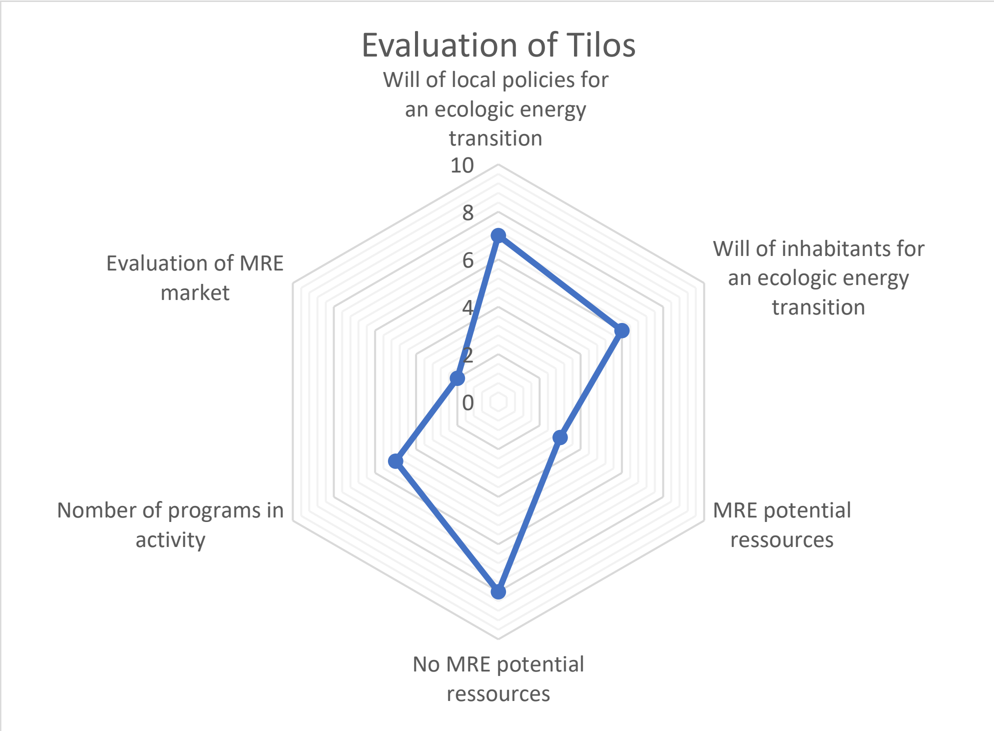
Salina:



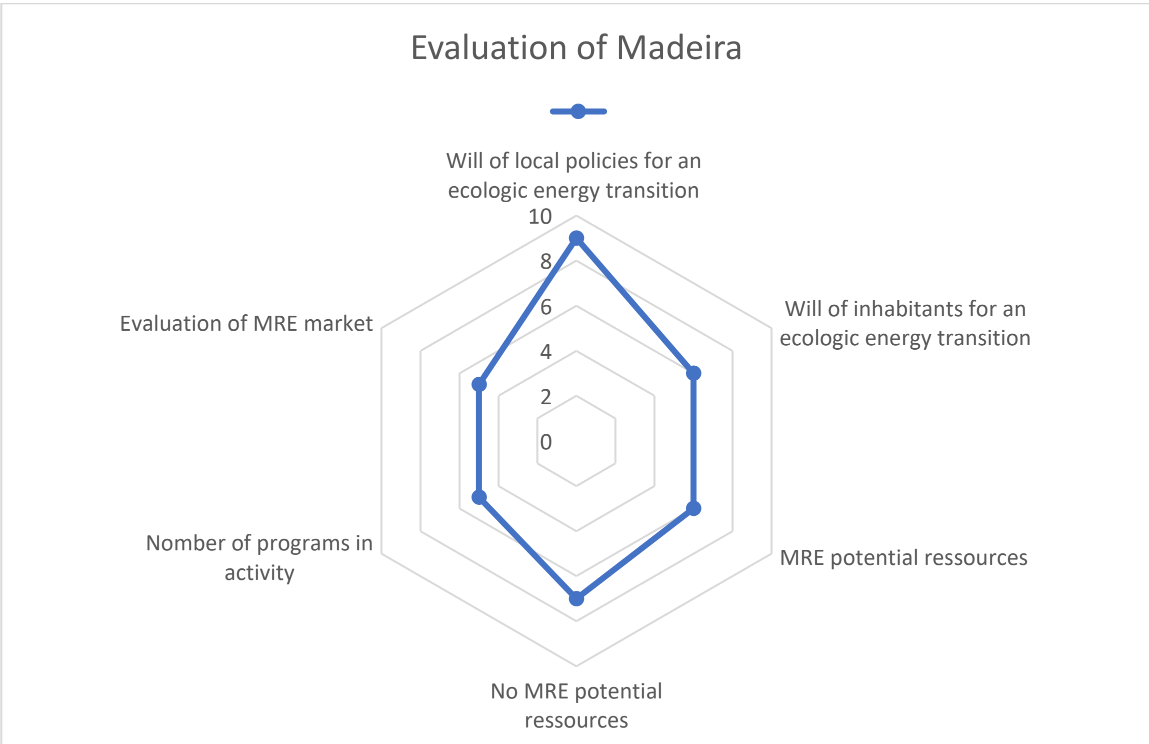
Kythnos:


Evaluation of Kythnos
Will of local policies for an ecologic energy transition
10
8
6
4
2
0
Will of inhabitants for an ecologic energy transition
MRE potential ressources
No MRE potential ressources
Nomber of programs in activity
Evaluation of MRE market

Tilos:


Evaluation of Tilos
Will of local policies for an ecologic energy transition
10
8
6
4
2
0
Will of inhabitants for an ecologic energy transition
MRE potential ressources
No MRE potential ressources
Nomber of programs in activity
Evaluation of MRE market

Madeira:

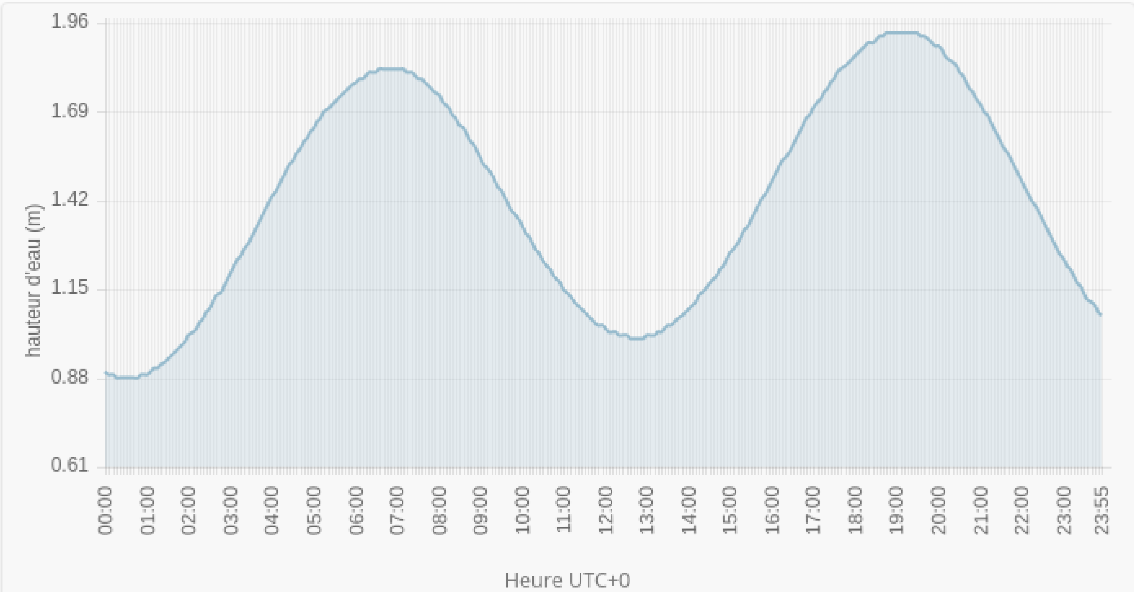

Evaluation of Madeira
Will of local policies for an ecologic energy transition
10
8
6
4
2
0
Will of inhabitants for an ecologic energy transition
MRE potential ressources
No MRE potential ressources
Nomber of programs in activity
Evaluation of MRE market

Funchal (Portugal)

Coordonnées : 032° 38' 37.2" N, 016° 53' 21.0" W

Annuaire de marées | Hauteur d'eau heure par heure | 12/07/2020 | UTC +0

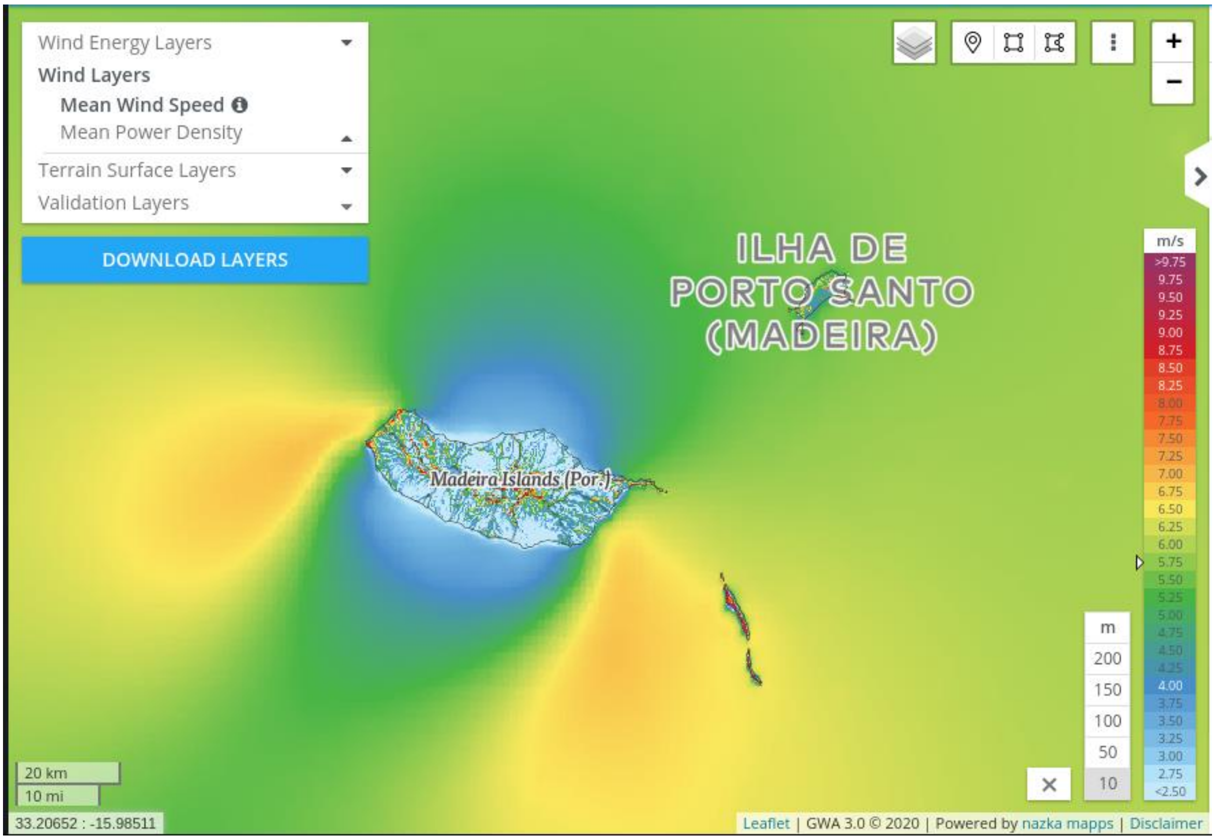
Dimanche 12 juillet 2020				Lundi 13 juillet 2020				Mardi 14 juillet 2020			
	Heure	Hauteur	Coefficient		Heure	Hauteur	Coefficient		Heure	Hauteur	Coefficient
BM	00:31	0.88	---	BM	01:26	0.94	---	BM	02:27	0.97	---
PM	06:51	1.82	---	PM	07:52	1.78	---	PM	08:58	1.79	---
BM	12:43	1.00	---	BM	13:49	1.05	---	BM	14:58	1.05	---
PM	19:08	1.93	---	PM	20:10	1.86	---	PM	21:16	1.84	---

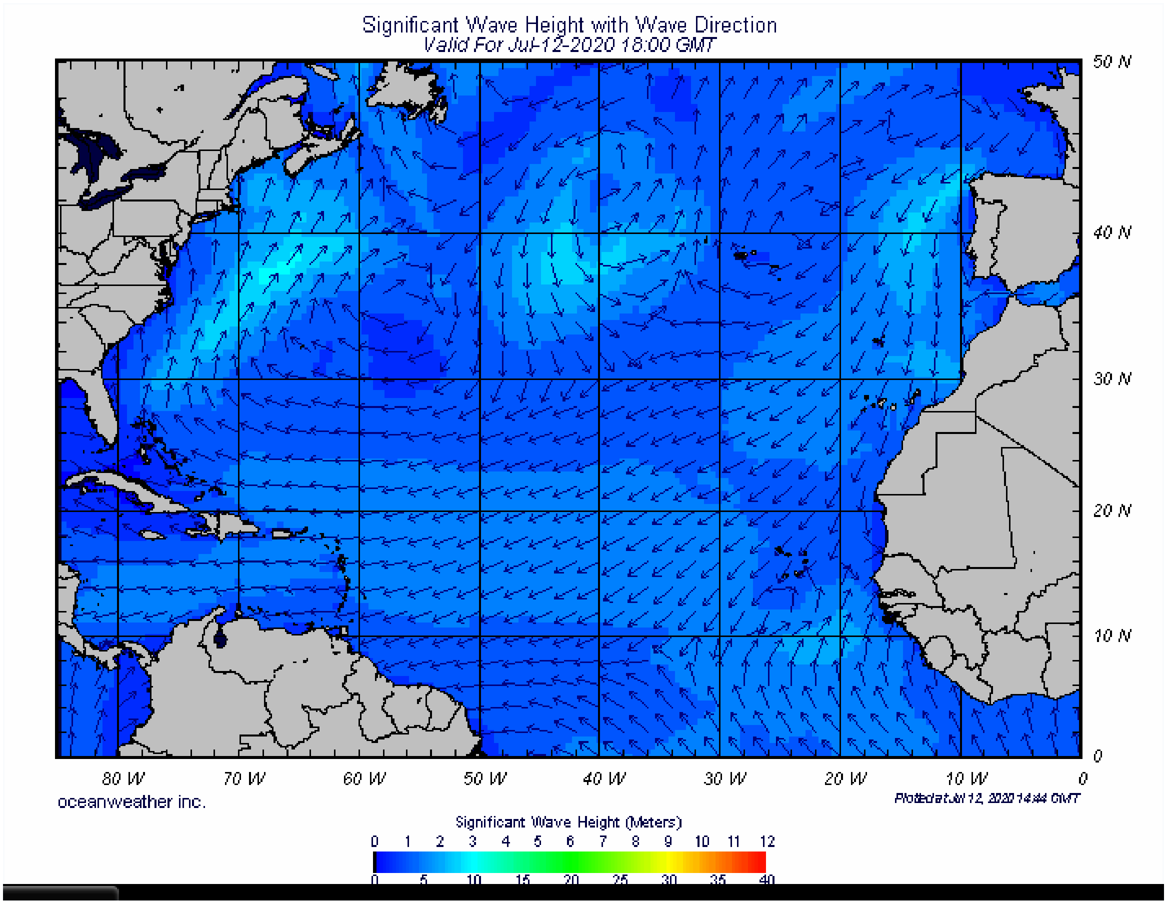


Vous pouvez visualiser la hauteur d'eau à une heure donnée (option hauteur d'eau) ou les heures à partir d'un seuil (option seuil).

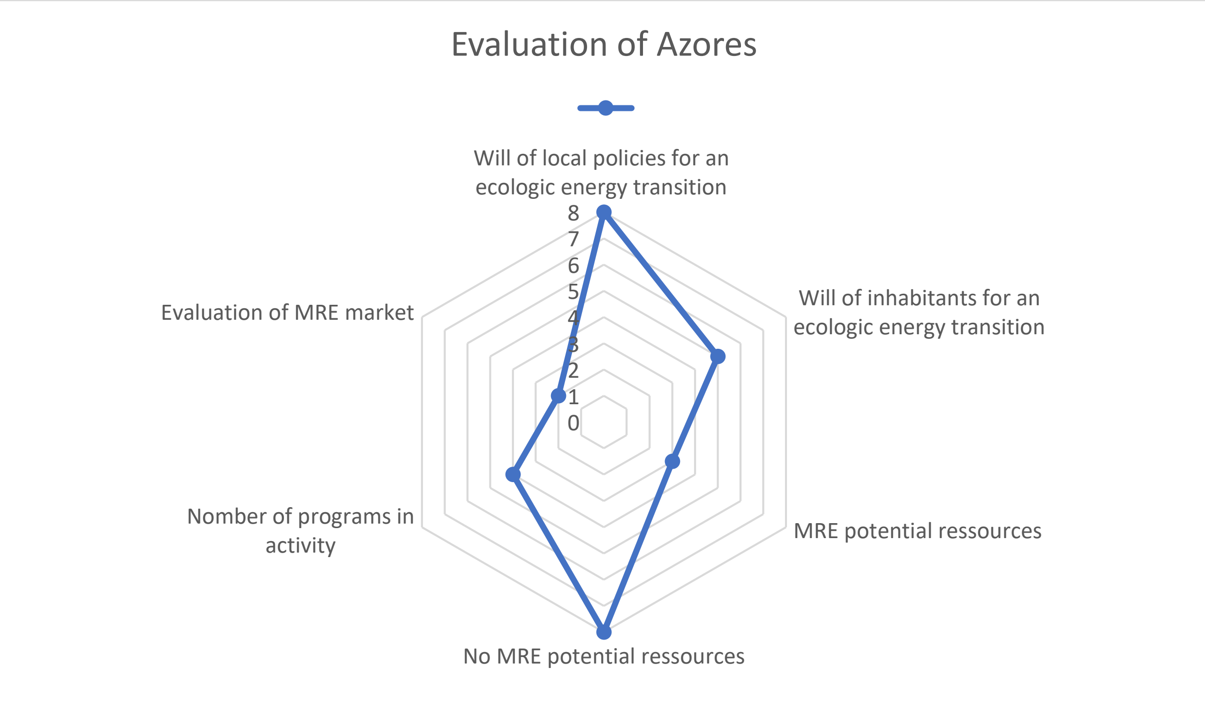
Cliquez sur le graphique pour placer votre ligne (maintenez le clic pour déplacer la ligne) ou entrez une valeur dans le champs suivant

○ Hauteur d'eau ○ Seuil ○ Aucun


Wind Energy Layers
Wind Layers
Mean Wind Speed
Mean Power Density
Terrain Surface Layers
Validation Layers
DOWNLOAD LAYERS
ILHA DE PORTO SANTO (MADEIRA)
Madeira Islands (Por.)
m/s
>9.75
9.75
9.50
9.25
9.00
8.75
8.50
8.25
8.00
7.75
7.50
7.25
7.00
6.75
6.50
6.25
6.00
5.75
5.50
5.25
5.00
4.75
4.50
4.25
4.00
3.75
3.50
3.25
3.00
2.75
<2.50
m
200
150
100
50
10
20 km
10 mi
33.20652 : -15.98511
Leaflet | GWA 3.0 © 2020 | Powered by nazka mapps | Disclaimer


Significant Wave Height with Wave Direction
Valid For Jul-12-2020 18:00 GMT
50 N
40 N
30 N
20 N
10 N
0
80 W
70 W
60 W
50 W
40 W
30 W
20 W
10 W
0
oceanweather inc.
Plotted at Jul 12, 2020 14:44 GMT
Significant Wave Height (Meters)
0 1 2 3 4 5 6 7 8 9 10 11 12
0 5 10 15 20 25 30 35 40

Azores:

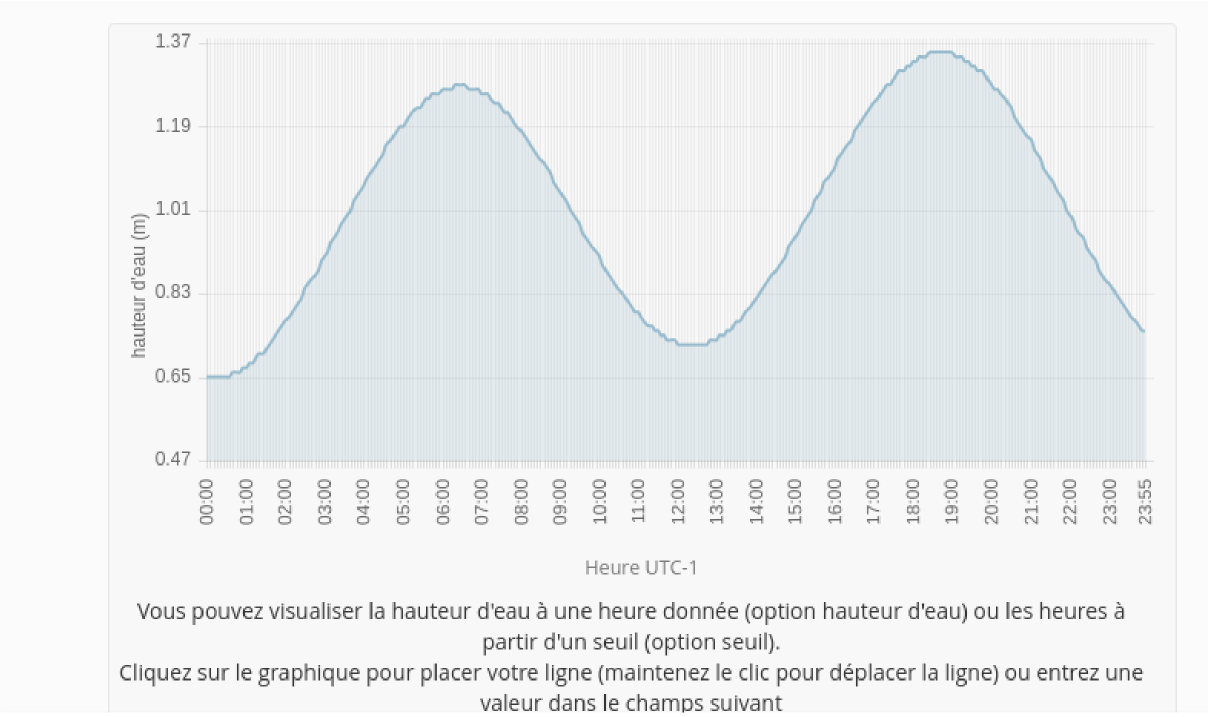


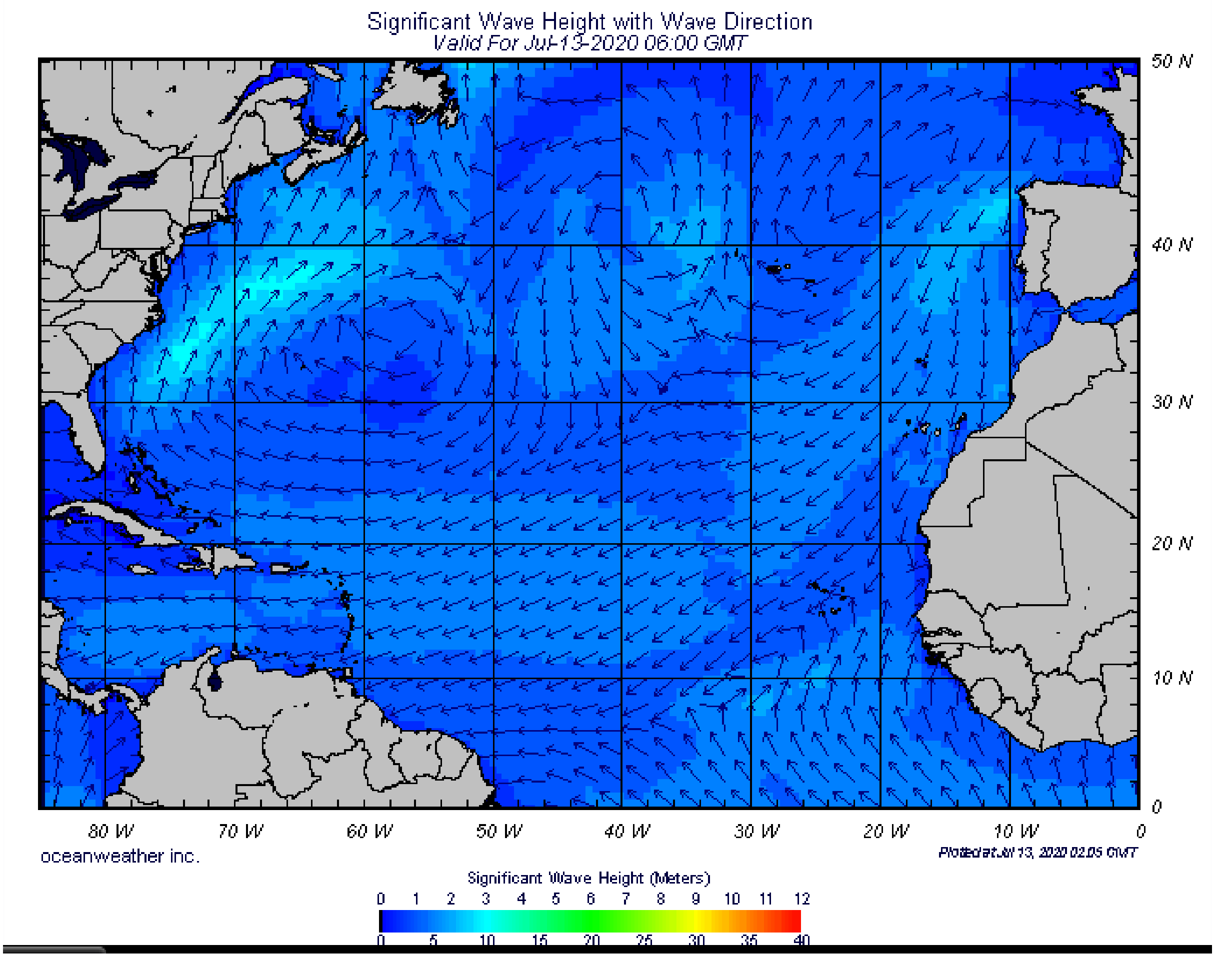
Ponta Delgada (S. Miguel) (Portugal)

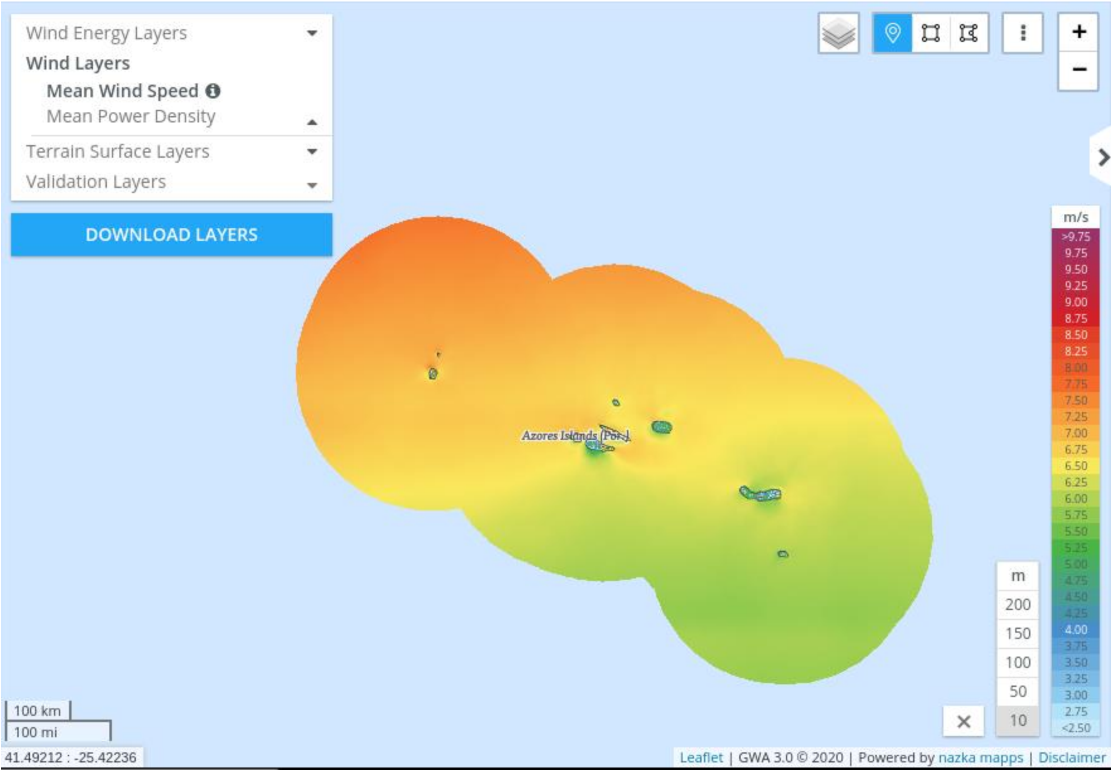
Coordonnées : 037° 44' 00.0'' N, 025° 40' 00.0'' W

Annuaire de marées | Hauteur d'eau heure par heure | 12/07/2020 | UTC -1

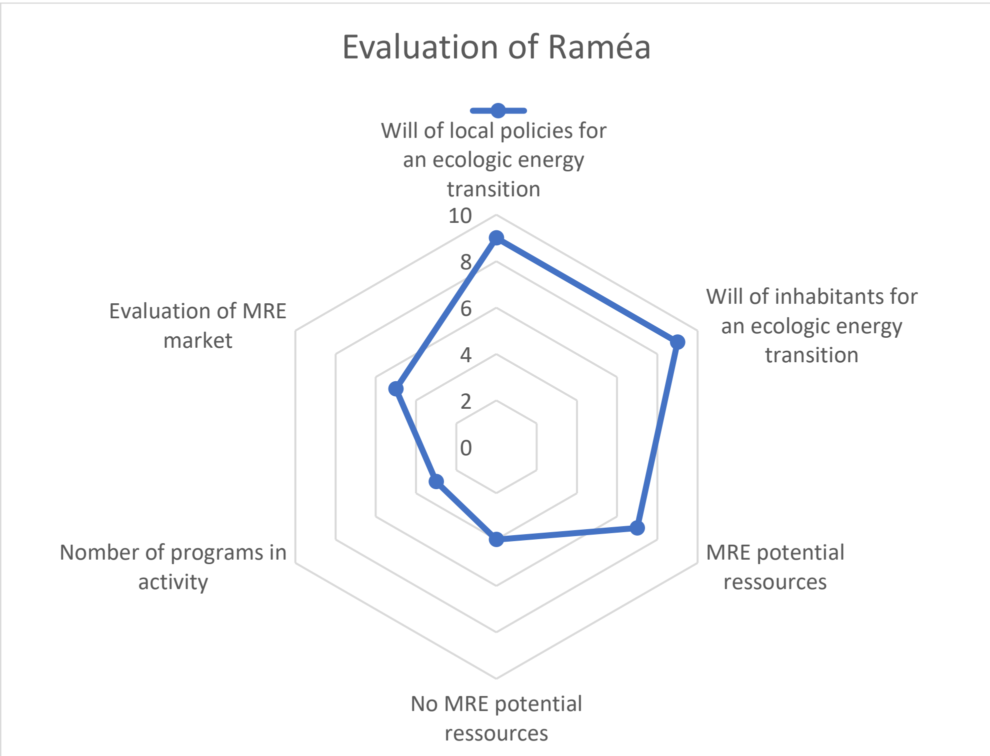
Dimanche 12 juillet 2020				Lundi 13 juillet 2020				Mardi 14 juillet 2020			
	Heure	Hauteur	Coefficient		Heure	Hauteur	Coefficient		Heure	Hauteur	Coefficient
BM	00:14	0.65	---	BM	01:11	0.69	---	BM	02:13	0.70	---
PM	06:27	1.28	---	PM	07:28	1.26	---	PM	08:33	1.27	---
BM	12:22	0.72	---	BM	13:27	0.76	---	BM	14:36	0.76	---
PM	18:42	1.35	---	PM	19:43	1.31	---	PM	20:47	1.30	---


1.37
1.19
1.01
0.83
0.65
0.47
hauteur d'eau (m)
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
23:55
Heure UTC-1
Vous pouvez visualiser la hauteur d'eau à une heure donnée (option hauteur d'eau) ou les heures à partir d'un seuil (option seuil).
Cliquez sur le graphique pour placer votre ligne (maintenez le clic pour déplacer la ligne) ou entrez une valeur dans le champs suivant


Significant Wave Height with Wave Direction
Valid For Jul-13-2020 06:00 GMT
50 N
40 N
30 N
20 N
10 N
0
80 W
70 W
60 W
50 W
40 W
30 W
20 W
10 W
0
oceanweather inc.
Plotted at Jul 13, 2020 02:05 GMT
Significant Wave Height (Meters)
0 1 2 3 4 5 6 7 8 9 10 11 12
0 5 10 15 20 25 30 35 40


Wind Energy Layers
Wind Layers
Mean Wind Speed
Mean Power Density
Terrain Surface Layers
Validation Layers
DOWNLOAD LAYERS
Azores Islands (Por.)
m/s
>9.75
9.75
9.50
9.25
9.00
8.75
8.50
8.25
8.00
7.75
7.50
7.25
7.00
6.75
6.50
6.25
6.00
5.75
5.50
5.25
5.00
4.75
4.50
4.25
4.00
3.75
3.50
3.25
3.00
2.75
<2.50
m
200
150
100
50
10
100 km
100 mi
41.49212 : -25.42236
Leaflet | GWA 3.0 © 2020 | Powered by nazka mapps | Disclaimer

Raméa :

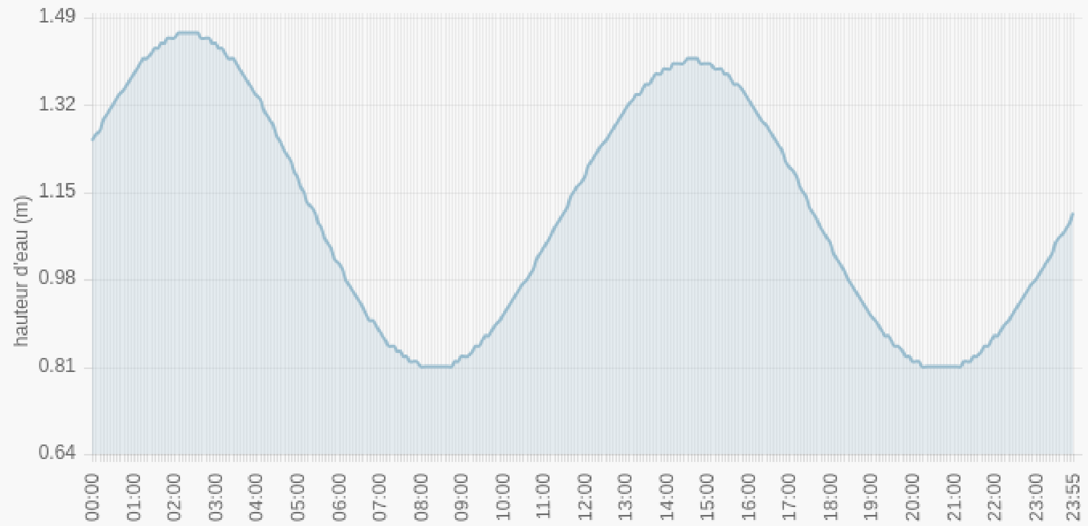

Evaluation of Raméa
Will of local policies for an ecologic energy transition
Will of inhabitants for an ecologic energy transition
MRE potential ressources
No MRE potential ressources
Nomber of programs in activity
Evaluation of MRE market
10
8
6
4
2
0

Port-aux-Basques (Canada)

Coordonnées : 047° 35' 00.0" N, 059° 09' 00.0" W

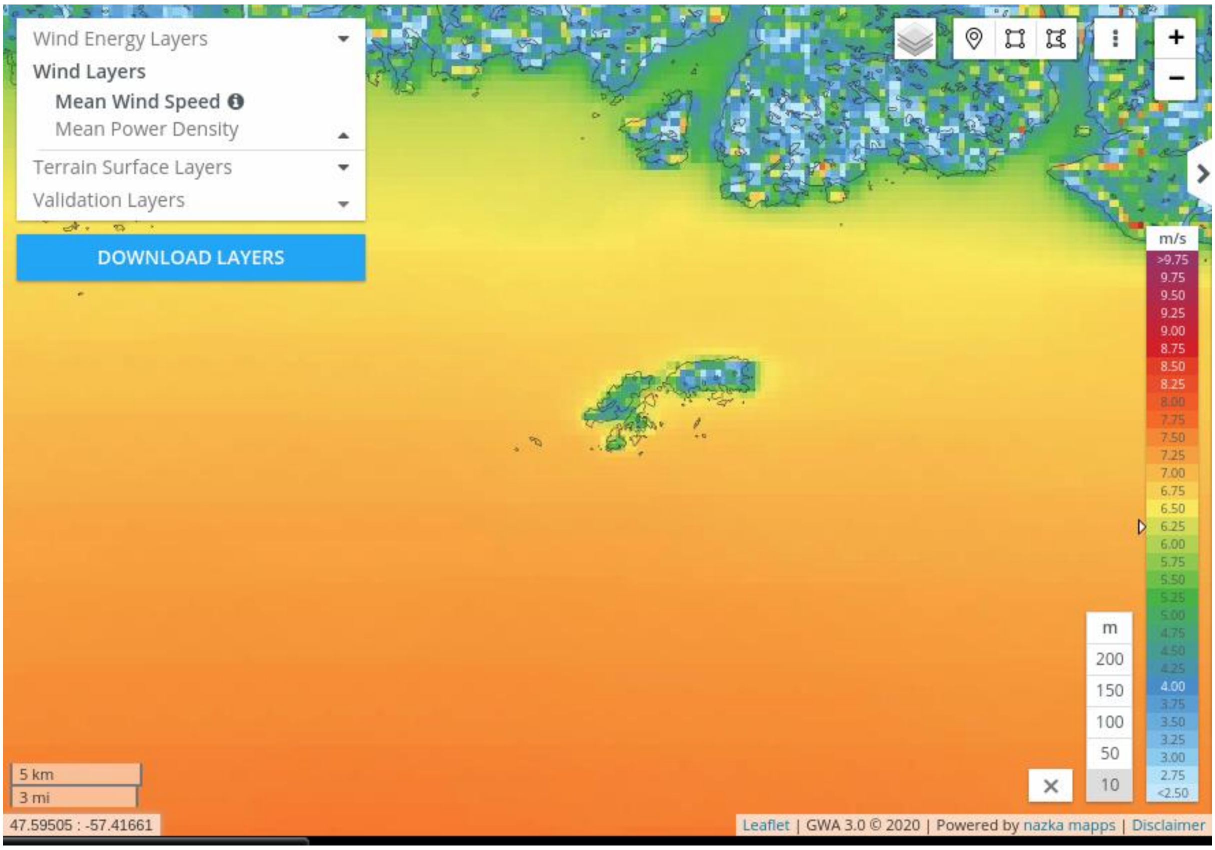
Annuaire de marées | Hauteur d'eau heure par heure | 12/07/2020 | UTC -3.5

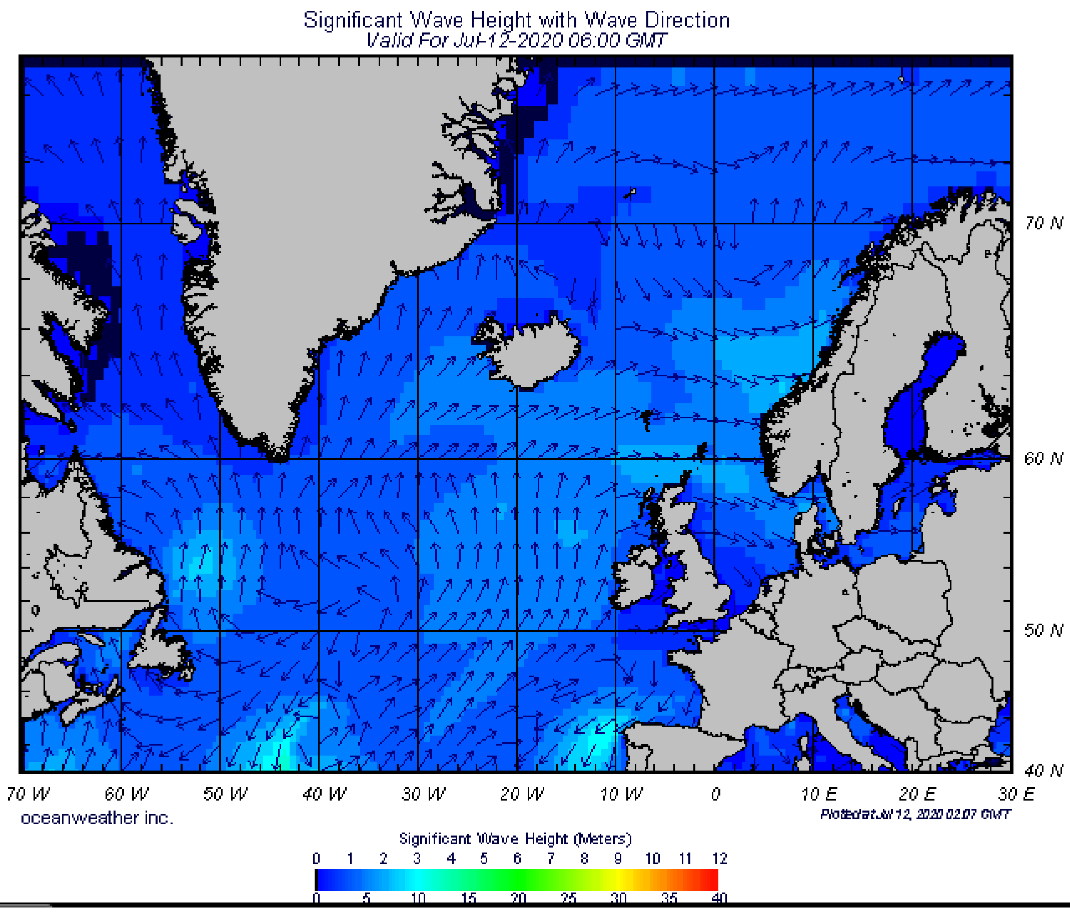
Dimanche 12 juillet 2020				Lundi 13 juillet 2020				Mardi 14 juillet 2020			
	Heure	Hauteur	Coefficient		Heure	Hauteur	Coefficient		Heure	Hauteur	Coefficient
PM	02:20	1.46	---	PM	03:03	1.40	---	PM	03:49	1.35	---
BM	08:20	0.81	---	BM	09:09	0.81	---	BM	10:05	0.79	---
PM	14:38	1.41	---	PM	15:35	1.41	---	PM	16:35	1.42	---
BM	20:42	0.81	---	BM	21:41	0.86	---	BM	22:44	0.89	---



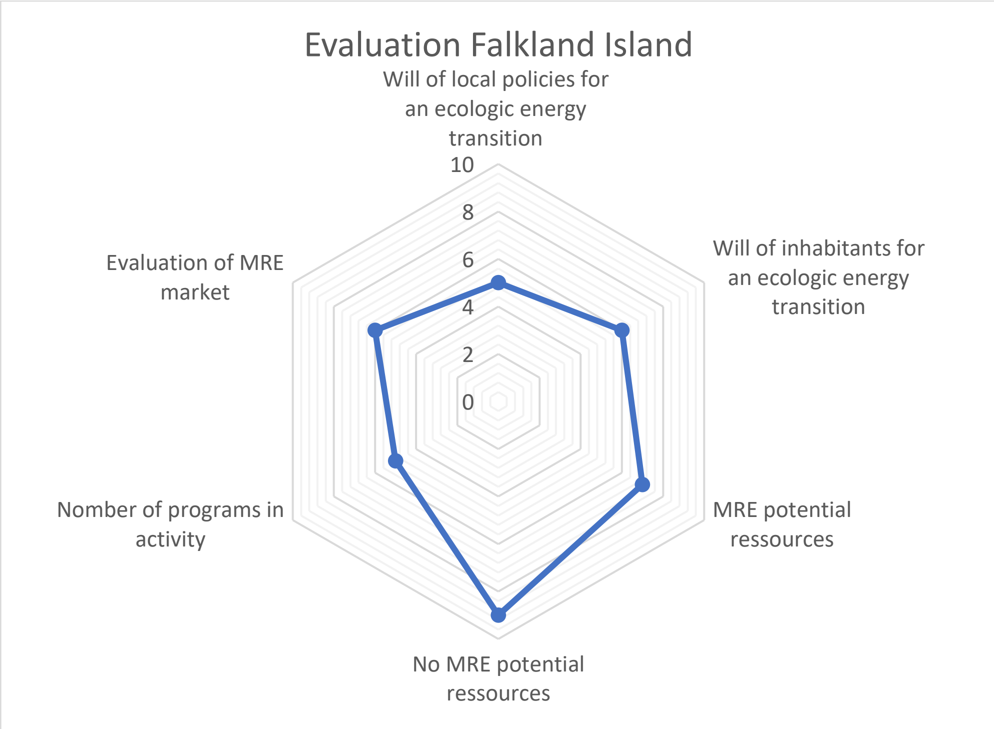
Vous pouvez visualiser la hauteur d'eau à une heure donnée (option hauteur d'eau) ou les heures à partir d'un seuil (option seuil).

Cliquez sur le graphique pour placer votre ligne (maintenez le clic pour déplacer la ligne) ou entrez une valeur dans le champs suivant


Wind Energy Layers
Wind Layers
Mean Wind Speed
Mean Power Density
Terrain Surface Layers
Validation Layers
DOWNLOAD LAYERS
m/s
>9.75
9.75
9.50
9.25
9.00
8.75
8.50
8.25
8.00
7.75
7.50
7.25
7.00
6.75
6.50
6.25
6.00
5.75
5.50
5.25
5.00
4.75
4.50
4.25
4.00
3.75
3.50
3.25
3.00
2.75
<2.50
m
200
150
100
50
10
5 km
3 mi
47.59505 : -57.41661
Leaflet | GWA 3.0 © 2020 | Powered by nazka mapps | Disclaimer


Significant Wave Height with Wave Direction
Valid For Jul-12-2020 06:00 GMT
70 N
60 N
50 N
40 N
70 W
60 W
50 W
40 W
30 W
20 W
10 W
0
10 E
20 E
30 E
oceanweather inc.
Plotted at Jul 12, 2020 02:07 GMT
Significant Wave Height (Meters)
0 1 2 3 4 5 6 7 8 9 10 11 12
0 5 10 15 20 25 30 35 40

Falkland Islands:



King Island :