

Orkney Energy Heritage Strategy Phase 1: Scoping

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**Orkney Energy
Heritage Strategy
Phase 1: Scoping**

Summary report

Project No: 1001

ORCA

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Introduction

Orkney has a long history of energy production, from the use of traditional fuels such as peat, to the more recent extraction and refinement of oil, exploration of uranium, and the current world leading renewables industry. The islands can claim to be early pioneers of renewable energy, with the development of wind power generation in the 1950s at Costa Head on Mainland (the first grid-connected wind turbine), to the tidal and wave power generation over the last decade, for example at Billia Croo, and the development of green hydrogen production.

These industries have an emerging history and have left physical traces in the landscape which can be recorded archaeologically. Along with the energy devices themselves and material culture surrounding energy sites, there are the stories and memories of the workforce and communities involved. More generally, industrial heritage can often be overlooked, perceived as unsightly and too recent to receive the recognition it deserves. There are various Scottish and UK strategies and research agendas which include industrial heritage, but as yet nothing that specifically deals with the unique energy story in Orkney.

Taking the importance of Orkney's global role in energy production, the wealth of physical and intellectual material that exists, and in response to wider industry aspirations for a joined-up approach to energy heritage in its broadest sense, there is a clear need for an Energy Heritage Strategy for Orkney.

The strategy would function to guide and prioritise current energy heritage initiatives and underpin future ones (e.g., field recording, archiving, curation, oral histories, heritage centre etc).

This scoping exercise was undertaken with a grant from the UHI Energy Innovation Hub and in-kind support from Aquatera and EMEC. It addresses the vision of the UHI Energy Innovation strategy 2023-25, 'leading and supporting energy innovation where the resource is' (UHI 2023: 2).

Aims and objectives of the strategy

Overall Strategy

Taking the importance of Orkney's global role in energy production, the wealth of physical and intellectual material that exists, and in response to wider industry aspirations for a joined-up approach to energy heritage in its broadest sense, there is a clear need for an Energy Heritage Strategy for Orkney (hereafter referred to as 'the Strategy').

The Strategy would function to guide and prioritise current energy heritage initiatives and underpin future ones such as field recording, archive collection and curation (documentary, digital and material), the collection of oral histories and development of a heritage centre.

The Strategy will be a multi-phased project, following two phases of development, Phase 1 to set out the 'state of the nation' in terms of the scope and scale of the task at hand, with the subsequent development of an action plan that will set out the scope of Phase 2.

Phase 1 of the Strategy (2023)

The aim of Phase 1 (this phase) is to:

- Undertake a high-level audit of the types of material that exist, such as devices, facilities, documentation, digital data, photographic, spoken and written histories.
- Identify energy sites.
- Understand industry aspirations and priorities for collecting and disseminating material and how this might be done.
- Explore the collection policies of museums and research strategies.
- Present an action plan for the development of subsequent stages of the Strategy.

Phase 2 of the Strategy (2023-24)

This will involve addressing the action plan set at Phase 1, and will:

- Produce detailed archive audits.
- Undertake interviews with key people.
- Hold a stakeholder workshop to gather detailed feedback.
- Establish agreed gaps in knowledge.
- Set priorities.
- Write the Strategy.

This will result in a first version of the Strategy, and it is anticipated that this will feed into policy making at a local to national level, help guide the recording, protection and management of energy sites, the curation of objects and collection of oral histories from the recent past, and supporting heritage considerations for existing, new and future energy initiatives. The Strategy will be designed to evolve as initiatives are undertaken and completed and will be regularly updated.

Phase 1 Methodology

A high-level review of archive material was undertaken using readily available online searches using the Historic Environment Scotland Canmore database; the Orkney Library & Archive service online catalogue; the Orkney Energy Landscapes project report and archive; and through initial discussions with the people and organisations outlined below.

To develop a robust understanding of the scale of the task in hand, meetings were undertaken with key people involved in the development and study of energy research, development, generation and use in Orkney from an energy industry, heritage profession, community and ethnographic perspective.

The meetings were intended to provide an initial steer to allow the development of a robust (but not exhaustive at this stage) understanding of the aspirations for industry and museums in relation to energy heritage, and the scale and location of material that survives such as documentary, digital, photographic and sound archives, as well as physical material associated with devices, exhibition materials, promotion materials, scale models for experimentation/simulation purposes, and the sites of the energy testing facilities themselves – both on and offshore.

We would like to thank the following for their incredibly valuable input to date, and for their continuing support as the strategy develops:

- Stephanie Strother – UHI North Highland / UHI Energy Innovation Hub
- Neil Kermode – EMEC / OREF Chair
- Gareth Davies – Aquatera
- Gavin Barr – Aquatera
- Laura Watts – Professor of Energy & Society, University of Edinburgh
- Becky Ford – Community Energy Scotland Island Community Action Network Development Officer, Community Energy Scotland
- Craig Smith – Repsol Sinopec
- Neil Gordon – Repsol Sinopec
- Janette Park – Stromness Museum (Curator)
- Ian Johnstone – Stromness Museum (Chair)
- Nick Hewitt – Orkney Islands Council, Museum Service
- Phyllis Gee – Flotta Heritage Trust
- Kenny Gee – Flotta Heritage Trust
- Martin Howe – Flotta Heritage Trust
- David Hourston – Flotta Heritage Trust
- Miles Oglethorpe – Head of Industrial Heritage at Historic Environment Scotland / President at International Committee on the Conservation of the Industrial Heritage

Orkney's Energy Archive

The material culture of Orkney's energy heritage comprises archives and objects, large and small, energy generating devices, device testing sites (both onshore and offshore), energy generating sites, and a wealth of oral and written histories. From our initial high-level review, it is apparent that there is a wealth of material culture (both known and as yet unknown) of different types, sizes and locations across the county and likely further afield (as devices are decommissioned).

In addition, and of intrinsic importance to Orkney's energy story, is the social history and memories that are entwined with the material culture of energy production, represented by the memories of those who have worked and continue to work in energy, and use energy, in Orkney. These people include the pioneering scientists who developed the ideas, the engineers who worked out how they could be implemented, the workers who made them a reality, the specialists, contractors and administrators who are today working on the operation and maintenance of existing and new sites; and the local population who have gained (or otherwise) directly or indirectly from the economic benefits created.

Archives

"Archives" means paper records of all types including engineering and construction drawings, together with photographic negatives and prints, film and sound recordings, and the electronic equivalents of these.

It is inherent in the nature of the activities and events associated with energy development, generation and use in Orkney that considerable quantities of paper, photographic records, videos and films have been generated, and this will likely continue to be the case into the foreseeable future. There will likely be three units for the management of such material, comprising documents and printed papers, architectural, technical and other drawings; sound archives and photographic material including film.

There is a valuable archive of film and television programmes that deal with oil and renewable energy development in Orkney. For example, during our initial research we have encountered a documentary aired by BBC Scotland's *Current Account* series in 1976 that looked at the impact of the Flotta oil terminal on the island, and from initial searches of the British Film Industry archive there are a number of items relating to Flotta from the 1980s and 1990s. In addition, the early days of wind energy in Orkney is discussed in Wyvern Television's, and the UK Government's Department of Energy sponsored, *An Eye to the Future* (BFI 2023), programme from 1988. News reels broadcast in the 1950s during the construction of the Costa Head wind turbine offer another example, accessible in the BBC archive and National Library of Scotland Scottish Screen Archive. Further research of the BBC Archives and the British Film Industry archive, as well as other repositories, will likely yield further programmes and snippets of interest that would form a significant part of the Orkney energy archives.

The Orkney Archive has some material relating to energy in Orkney, however the list was not as extensive as anticipated. Initial general searches of the archive catalogue showed very little material for 'renewable energy' (perhaps as this material has yet to leave industry stakeholders) but more for Flotta Oil Terminal (however this appears restricted to high level report and pamphlets, rather than operational documents for the terminal). There is a wealth of material relating to the uranium saga in Orkney and the public opposition to uranium mining in the county in the 1970s and 1980s. As part of the next phase of the strategy, a full search

of the archive will be undertaken and this will include the photographic, sound and film archives along with the documentary archives.

Industry stakeholders hold a number of paper, digital and object archives. These have been collected over the last two decades and are currently housed in organisation offices and storage facilities. Little work to catalogue this archive material has yet been undertaken and an assessment of the suitability of storage facilities is required (e.g., controlled environment).

Less tangible, but no less important, is the enormous amount of recorded and unrecorded oral histories relating to energy production in Orkney, from the early days of oil in the 1970s, through to the renewables sector from the late 20th century onwards. In recent years there has been a lot of work put into collecting oral histories associated with the oil and gas industry, and this has been collected by the *Lives in the Oil Industry: oral history of the UK North Sea Oil and Gas Industry* (University of Aberdeen & British Library Sound Archive 2010) archive. This impressive and highly valuable archive includes oral histories from those involved in the construction and operation of the Flotta Oil Terminal.

There have also been periods of informal collecting of oral histories relating to the development and adoption of renewable energy in Orkney, for example by EMEC and the Flotta Heritage Trust.

Energy devices

Associated with the energy sites are the energy devices themselves, which often lose their importance as they are superseded by new technologies and innovations and quite often are abandoned or more commonly dismantled. Some devices have survived for several years, such as the recently scrapped Seatricity floats stored at the boat yard, Ness, Stromness.

In Orkney there are several devices that still survive in whole, including the P2 Pelamis Wave Energy Converter that is tied alongside Lyness Pier, the Wello Penguin (on the seabed) as well as parts of devices such as the P2 Pelamis nose cone in a Benith'ill Café play park in Moaness, Hoy. The onshore facility and turbine hall for the Oyster 800 device survives on private land at Billia Croo.

These energy generation devices are key parts of Orkney's energy story, and they need to be considered as an integral part of the overall energy archive.

Objects

Objects are generally classified according to their use or intended use (which may or may not be the same thing). They can also be categorised by form and function, for example, tools, furniture, clothing etc.

Across the county in places associated with energy research, development, generation and use, there will be a lot of objects, and these will likely fall into a number of broad categories:

- Generic or special tools and equipment associated with work activities undertaken at energy sites.
- The personal effects of those who work or have previously worked at energy sites and offices.
- Instructional models of devices / installations.
- Commemorative items such as device models, plaques, awards etc.
- Unused stocks of consumable materials or components, and spare components.

- Broken, worn-out, time-expired or redundant items in any of the previous categories, which may have been discarded but which have not been moved from locations.

There will likely be lots of other objects in existence that do not fit into the above categories.

Energy Sites

There are numerous energy generation and testing sites in Orkney, both onshore and offshore, operational through to mothballed, and decommissioned. These sites range from a Norse (potentially) horizontal mill in Orphir, through to windmills and watermills of 17th century date onwards, mid-20th century wind energy experimental sites on Costa Hill and wave and tidal energy test sites and associated infrastructure at Billia Croo and Falls of Warness. The energy sites are explored in more detail below (see also Appendix 1).

Energy Sites

The sites where energy is ‘made’ are a highly significant part of Orkney’s energy story, being the end result of years, if not decades, of research, design, innovation, consenting, construction and operation. These sites will be an integral part of Orkney’s Energy Heritage Strategy, and it is critical that their part in the energy story is told, and their presence in the landscape acknowledged (whether *in situ* or not).

Significant archaeological work has already been undertaken on a range of energy sites in Orkney, and this work is presented in the Orkney Energy Landscapes project archive (Lee & Irvine 2023). The project explored energy sites in Orkney, with the aims of placing the energy story in the history of Orkney and establishing a model for community-based investigations and recording. Energy themes of peat, oil, uranium, wind and wave were explored at Eday peat railway, Flotta Oil Terminal, Billia Croo wave energy test site, Costa Head wind turbine, Burgar Hill wind turbines and the Uranium Corridor near Stromness that starts at the Mill of Cairston. The work undertaken as part of this project is of intrinsic value to the Orkney Energy Heritage Strategy providing a model for public engagement, field recording and dissemination.

In addition to the energy sites explored previously, there are a wealth of other sites and locations within Orkney that are associated with energy, ranging from historic examples of windmills, wind engines and wind pumps, peat extraction sites, fuel storage sites and pumps, watermills, power stations and gasworks; through to modern and current tidal and wave energy test sites (both on and offshore), hydrogen fuel production and storage, wind farms, microrenewable sites (private wind turbines and solar panels), as well as oil at Flotta.

Set out in **Appendix 1**, energy sites have been listed starting with non-operational sites from the earlier periods of history, progressing through to current operational energy testing and generation sites. This initial list is not exhaustive and has been compiled using online sources such as Canmore, the EMEC website and from other energy research projects such as the Orkney Energy Landscapes Project (*ibid*).

Industry aspirations and priorities

Renewable Energy

Initial discussions demonstrated that it is clear from an industry perspective that there is an urgent need for a heritage strategy to capture living history, knowledge and archive material at a time when research and development is actually happening. In addition, there is a need to foster that collective sense of history, and importantly to inspire others to get involved in the industry, particularly relating to the next generation of Orkney renewable energy pioneers.

In terms of attracting investment, it was considered that the heritage strategy would help raise awareness of the story of renewable energy development in Orkney.

In terms of priorities, the collection of oral histories was identified as urgent before these stories are lost. For example, the first wave energy machine that supplied electricity to the grid at Costa Head, and the current precarious future of the Pelamis P2 device moored up at Lyness.

In addition, a need for the provision of expert advice to archive holders on how to handle archive material, be it large-scale devices through to paper and digital archives. There is also a need for a purpose-built archive facility, such as the UK nuclear industry Nucleus centre in Wick, that could curate the archive, and potentially be a home to the models and devices.

Flotta Oil Terminal

A visit was made to the terminal operated by Repsol Sinopec. The meeting concluded with a tour of the administration/control building and a driving tour of the terminal itself.

From the outset, there was a clear interest to be involved in the heritage strategy process and the benefit of this could be seen, and this was particularly timely for the Flotta oil terminal at a time of potential change. The end date of the terminal based on oil field production is currently the early 2030s and is now in an upgrading phase after a sustained period of low production, with the potential change to the Flotta Hydrogen Hub in the near future. Many of the installations are still original from the 1970s and most of the installations are oversized for the current output. Many installations are mothballed or decommissioned (e.g., both 1 million barrel storage tanks).

In terms of physical material, there are a large number of hard documents including permits to work, notebooks, plans and drawings dating from the 1970s onwards. There is currently no strategy for the collection, cataloguing and archiving of these, with the importance of having something in place being acknowledged in the meeting.

There is an extensive digital archive that is currently not catalogued, and this includes an extensive photographic archive of both digital images, video and digitised historic images.

There is a large site model that was built in the 1970s in the main meeting room, and across the administrative buildings there are trophies, mementoes, models, artefacts, framed photographs and other items that are part of the terminal story.

The common subject of the collection and curation of oral histories was discussed, and as with elsewhere this was considered a vital part of the terminal's story. Aligned with this is the fact that Flotta is a 'family terminal', with up to three generations of the same families having worked there meaning there is a generational investment in the place, as well as the clear community links that are of wide-reaching benefit to Orkney. Of note is the *Lives in the Oil*

Industry oral history archive, within which is a 2003 interview with the former deputy terminal manager Max Gunn.

Heritage sector aspirations

National

On a national level, there was a draft Industrial Heritage Strategy for Scotland drawn up in 2015, however this has no formal status, and it has not been adopted (pers. comm. Miles Oglethorpe, June 2023). Notwithstanding, the document highlighted the value of Scotland's industrial heritage, and the importance of raising awareness of the contribution made by Scotland to social and economic development across the world, and Orkney is a fundamental part of this.

Scotland's energy sector has clearly moved on from coalfields, and through the development of a unique offshore oil and gas industry we now have a thriving renewables sector that has been built upon the skills, knowledge and experiences of our energy pioneers.

Stromness Museum

Stromness Museum is an independent museum governed by a board of trustees with a focus on natural science, local history and the heritage and culture of Orkney, especially Stromness.

The current Collections Policy (2018-2023) (Stromness Museum 2018) has a specific collection theme of 'Development of the Renewable Energy industry in and around Stromness' (p10), and this falls under the Maritime theme and currently appears focused on tidal energy production. This theme is a future priority for collecting, to include artefacts and material relating to the development of the renewable energy industry in Orkney, and specifically Stromness (as the heart of this industry).

The museum's collection development policy states the following in relation to energy:

Development of the Renewable Energy industry in and around Stromness (p.10).

This theme is related to the development of the recent maritime history of Stromness. Orkney and especially Stromness has been at the forefront of the development of tidal renewables. Collecting takes account of the fact that the Orkney Renewable Industry has been identified as a major theme of interest for future collecting of Orkney Arts, Museums and Heritage.

Themes and priorities for future collecting (p. 12)

The museum seeks to expand its collecting policy to accommodate the future collecting of artefacts and material relating to the development of the Renewable Energy Industry in Orkney, in particular the geographical area of the burgh and parish of Stromness. The heart of the Renewable Energy Industry is in Stromness, and it is felt that this is an important area in the development of Stromness and the future history of the town. This is a natural continuation of the Orkney Natural History Society purposes and specifically relates our natural and maritime history collections.

The museum stressed the position of Stromness being at the heart of renewable energy development in Orkney, with the HQ of EMEC, Heriot Watt University campus, specialist consultants and the Billia Croo tidal test site being located nearby. There is a clear desire to be at the heart of telling the renewable energy story, but a sustainable project plan will need to be in place first in order to allow funding and space to be secured.

Orkney Museum

Initial consultation with the Orkney Museums Service was undertaken by email. The museum service is keen to be involved in the heritage strategy and gave a clear acknowledgement of the importance of the strategy initiative.

The current Collections Policy (Orkney Museum 2019) covers energy in general under the heading of 'Commerce and Industry'. While there is no specific mention of the energy industry it is understood that should energy become a significant collecting strand then Orkney Museum would consider adding a new header when the collections policy is reviewed in 2024 (Nick Hewitt, pers. comm., June 2023).

Scottish Research Framework (ScARF)

Energy landscapes and infrastructure is mentioned in the Modern Scotland panel report in relation to human-environment relations and landscape (Dalglish & Tarlow 2012). Reference is made to the oil industry, mills and renewable energy (p103), but specific research recommendations are not included on these topics, other than to 'recognise modern landscapes as multiple phenomena' which can include industrial landscapes (p105).

Flotta Heritage Trust

The focus of initial discussions with members of the Flotta Heritage Trust was on how the development of the oil terminal impacted Flotta, and how to better tell the story of the island, pre and post oil terminal. The Trust were keen to support the Strategy and were interested in how it could help them to deliver greater leverage on their planned initiatives relating to this. Additionally, they would welcome discussions regarding archive material and to establish solutions for their curation and display.

The trust has a range of items relating to the terminal that are in their care (and on display) at the island heritage centre; and they would like to collect more. This would be dependent on having more appropriate space, and a new heritage centre is currently identified as a priority. The collecting and recording of oral histories is seen as a priority, particularly relating to the construction and use of the terminal. Aligned with this is a need to collect and show film footage of the terminal, with a particular example being BBC Scotland's 1975 *Current Account* programme on the coming of oil to Flotta that was broadcast in January 1976. A DVD of this is held by the trust.

Energy stories

Initial discussions made it clear that there are multiple voices related to energy in Orkney that need to be heard – both industry and community. There is an acknowledgement that there will be different versions of the same story which can be told in different ways and by different voices. An overarching story needs to demonstrate the energy continuities from early prehistory through to the present day (and the future), underpinning the recent oil and renewable energy ‘revolutions’ as part of a longer process of human technological development and innovation.

It is important to recognise the energy narratives that exist in Orkney, and the key moments when decisions were made, which need to be captured (e.g., the 1998 energy conference in Orkney, the energy stories of Westray and Eday), along with different responses to storytelling such as through the arts in partnership with local creative bodies.

Heritage can be used as a tool to discuss the wider energy narratives (e.g., climate change, energy solutions) and to help with conversations. Energy has shaped communities, land and politics for thousands of years and is now in a period of rapid change, which heritage can help materialise. This was identified as being particularly important where some energy regimes have been ‘done’ to communities and people, often leaving negative effects both tangible and intangible.

Cross cutting themes

Initial discussions with industry, the heritage profession and community energy specialists has highlighted that there are significant opportunities associated with research into Orkney’s energy heritage.

These can be summarised so far as the need for:

- Individual heritage strategies for energy sites
- Archive audits
- Collection of oral histories
- Development of museum collection policies
- Community arts-based activities / responses
- Individual research projects relating to energy use and development, and
- Exhibitions (both static and travelling).

Discussions with industry and individuals have identified that there is a **desire for a permanent facility in Orkney to house the energy heritage archive** and to be a place where Orkney’s energy story has a home. It is recommended here that taking this initiative further into a feasibility stage in the first instance would be of significant benefit to Orkney’s energy heritage. A comparative example is Nucleus¹, the home of the UK’s atomic energy archive in Wick, Caithness.

The following is an initial list of potential spin-offs that could complement the heritage strategy. These are based on our initial engagement and discussions, and it will grow as the strategy develops. The listing below does not mean that these topics have been discussed in depth or

¹ <https://www.highlifehighland.com/nucleus-nuclear-caithness-archives/> [accessed 11 July 2023]

indeed committed to; however, they represent some of the potential that exists for future research:

- Flotta Oil Terminal Heritage Strategy – given the terminal is in a period of change that includes decommissioning and dismantling of a number of facilities, there is a clear opportunity to develop a strategy that would help the terminal operator to ensure the appropriate documentation / recording of this process and collection and care of archive materials and objects. This opportunity would require discussion with Repsol Sinopec.
- Funded academic study – detailed academic study of energy sites and innovations has the potential to reveal new insights into its social history, development, impact on the county and international status. This type of work can provide new evidence and understanding to inform future generations and interpretation initiatives.
- Recording projects – we have already identified a number of subjects that would benefit from further research, including an assessment of surviving public and private gaslights in Orkney; petrol/diesel pumps and historic garages; the threshing mills of Westray and Papa Westray; the history of microrenewables in Orkney; the early adoption of electric power in Orkney, and many more.

Action Plan for Phase 2

1. Audit of material culture

A detailed audit should be undertaken of evidential material in the form of archives, objects, records and oral history as these can reveal much about places, events and the evolution of ideas.

Developing a robust and broad-ranging body of evidential material for Orkney's energy story can, therefore, make a significant contribution to Orkney's cultural legacy.

Undertaking the audit would allow us to start the process of developing a collection of evidential material; and documenting events and buildings/structures/devices in non-active sites; and modifications and decommissioning as an inherent part of site activities in active sites.

2. Workshops with stakeholders

Once the audit of material culture has been completed, workshop(s) will be held to identify and agree on the aims and objectives of the Strategy, and to gather feedback in order to establish gaps in knowledge and to set priorities for it. It is intended that the Strategy will feed into policy making, help guide the recording, protection and management of energy sites, the curation of material culture and collection of oral histories from the recent past and support heritage considerations for new energy initiatives now and in the future.

The workshop(s) will also include interviews with key people in order to agree on who would 'own' the strategy, and how it would be adopted, monitored and updated.

The workshop(s) would be held in Orkney and would bring together people involved in the Phase 1 consultations, and others from the energy industry in Orkney, from Orkney's museums, heritage trusts and Historic Environment Scotland, from Orkney Islands Council, and people & organisations with interests and specialist knowledge on energy and communities.

3. Orkney Energy Heritage Strategy

Once the archive audit, interviews and workshop(s) have been completed there will be a period of consolidation, during which the drafted final heritage strategy will be produced. This will be presented to stakeholders for a single round of review, comments and updating.

The primary aim of the strategy will be to set out a clear approach to the management of Orkney's energy heritage, based on a robust understanding of the cultural values associated with its many and varied different aspects, and the realities of the research and development process. In this context, several broad aims and objectives for the strategy will be set that will potentially cover approaches to engagement; the treatment of material culture; securing a cultural legacy for Orkney's energy; strategies to provide sustainable public benefit to Orkney's communities; establishing processes for making decisions on material culture; and guidance on the treatment of intangible heritage.

The strategy will be developed in accordance with best practice methods of conservation management planning in the UK. It will be founded on a robust understanding of Orkney's energy heritage and its cultural values and on a clear recognition of the issues and external factors relating to the rapidly evolving renewable industry.

While the form of the Strategy is not yet known, based on best practice there will likely be a few broad stages of its development that are outlined below:

Stage 1: Understanding Orkney's energy story

Research and analysis of the energy story including history, development and current situation. It will set out the nature and character of surviving material culture, social history and some defining non-physical characteristics of the story.

Stage 2: Exploring cultural value

This will essentially be an assessment of the historical and cultural significance of Orkney's energy story. It will likely include an exploration of where Orkney sits in the context of the national and international energy story, and then explore the different values of its material culture.

Stage 3: Comparators

A key stage of the strategy will be researching into and contact with other establishments / organisations who are developing similar strategies, such as the Norwegian Petroleum Museum in Stavanger.

Stage 4: Exploring approaches to developing a cultural legacy

This will set out what should be celebrated, conserved and communicated in relation to Orkney's energy story, and looking at how it could be cost effectively done. It will explore key themes and identify options and ideas that, based on available evidence, are deliverable.

Stage 5: Activities

A key aim of the strategy will be to ensure a broad consensus on the way forward. This will set out activities that will be undertaken to deliver the strategy.

Stage 6: Implementation

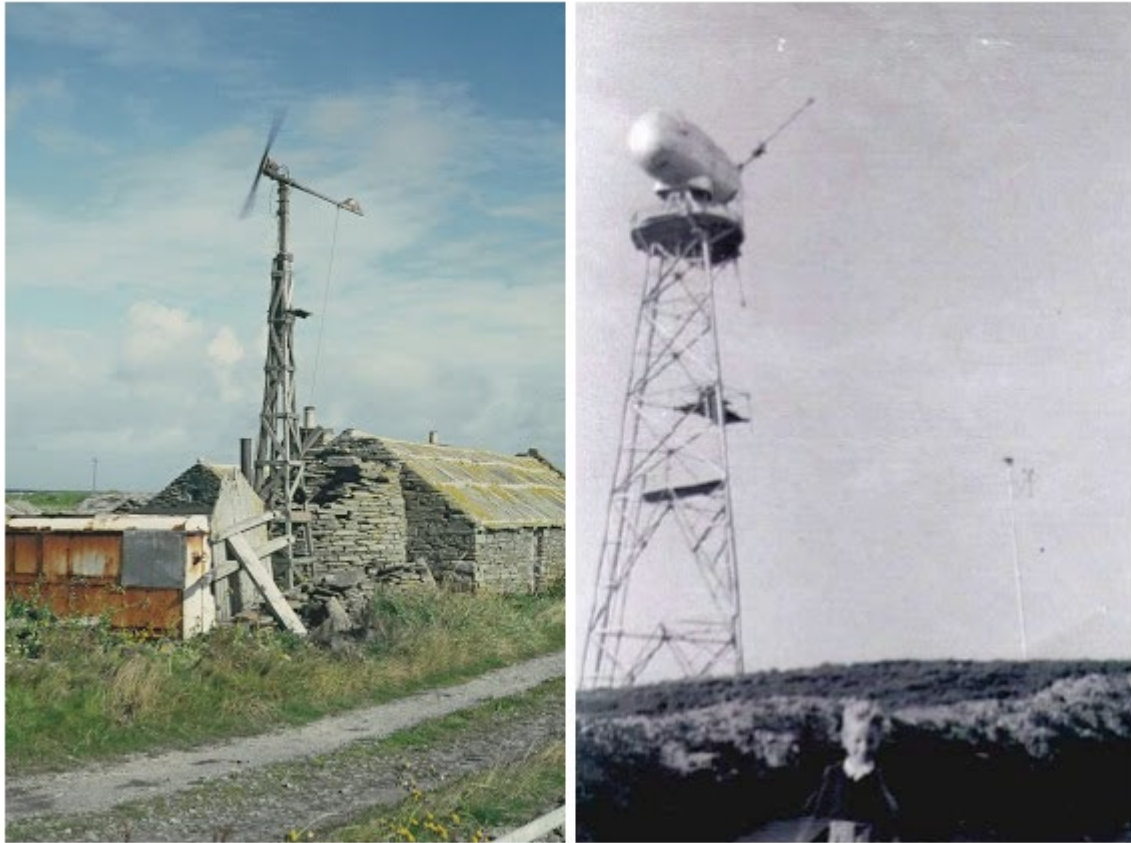
Outlining how the activities outlined in stage 5 will be implemented.

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Appendix 1: Energy sites

FORMER WIND ENERGY SITES



Left: Fish-house, Sanday (© Canmore 192032), Right: Costa Head turbine (© Aquatera Ltd)

Across Orkney are the remains of wind energy sites, from electricity producing wind turbines at Costa Head and Burgar Hill, to sites that harnessed wind energy to power mills, engines, threshing machines and water pumps from the post-medieval period onwards. The following list identifies the known wind energy sites in Orkney, that are listed in Canmore. This list should be considered to be incomplete, and there are more than likely a lot more small-scale wind energy sites that survive above and below ground.

Of particular note are Costa Head and Burgar Hill that were key locations for the testing and operation of wind turbine technology from the 1950s onwards. These sites have been recorded by the Orkney Energy Landscapes Project (Lee & Irvine 2022). In addition, some of the examples of wind powered threshing mills on Papa Westray and Westray represent innovations that have been developed through necessity and availability of resources that make them unique sites without any known parallels in Scotland (and possibly further afield).

Site	Description
Wind turbines / Windfarms	
Costa Head	The remains of the world's first grid connected wind turbine comprising anemometers, a turbine base and control building. Large anemometers were erected by William Golding in the late 1940s to test the site for an experimental wind turbine. Steel framework from the largest anemometer tower was present on the site until recently and is pictured in Canmore. The concrete base of the largest anemometer (HY 31068 29770) is still visible to the NW of the building surrounded by three concrete cable anchor points.
Burgar Hill	Burgar Hill has been the site of a number of wind generators for research and commercial purposes from 1980. Three wind turbines were built here in the 1980s, and these experimental turbines demonstrated that large-scale wind energy production was possible. The concrete foundations of all three experimental turbines are still visible. There are currently six turbines at the site, varying in scale from 1.3MW to 2.75MW, with tip heights from 76 m to 116 m.
Windmills / Post mills / Wind engines / Threshing machines / Wind pumps	
Windmill at Earl's Knoll, Papa Stronsay (Canmore ID: 3290)	The monument comprises a long turf-covered mound surmounted by the remains of a dry-stone windmill base. The windmill-base consists of a low circular dry-stone plinth. It measures some 3.3m diameter at the base and is about 1.2m high.
Windmill at Scar, Sanday (Canmore ID: 3540)	This is part of a large 19th century farm built for the Traill family of Westove, which includes a lectern dovecote and a later steam-powered meal mill. The conical stone windmill base is all that remains of a number of windmills in Sanday in the 19th century.
Windmill at Sunibrae, Sanday (Canmore ID: 3620)	This site is of principal interest for the remains (the best-preserved on Sanday) of a wind-engine-driven threshing machine. Now disused and ruinous.
Windmill at Hack's Ness, Sanday (Canmore ID: 3475)	Likely windmill foundation of 18 th /19 th century date on top of a prehistoric burial mound.
Windmill at Lettan, Sanday (Canmore ID: 116483)	This linear range incorporates a house, barn and byre and the site of a windmill
Wind engine at Lettan, Sanday (Canmore ID: 3575)	Location of wind engine, condition and survival unknown.
Wind engine at Rusness, Sanday (Canmore ID: 3621)	This site is of principal interest for the remains (the best preserved on Sanday) of a wind-engine driven threshing machine, previously surveyed for the Scottish Industrial Archaeology Survey. The site is disused and ruinous.
Windmill at Peckhole, North Ronaldsay (Canmore ID: 3672)	Peckhole was the last working windmill in Scotland, the rubble base topped by a jettied timber revolving sail house and 4 sails. This section is now missing but a drawing by T S Peace shows the mill in working order, with the long tail beam allowing the sail house to be moved to face the wind. The windmill operated until about 1908 when it was replaced by a diesel engine-powered meal mill to its immediate north-west.
Windmill, Linklet, North Ronaldsay (Canmore ID: 3673)	Location of windmill, condition and survival unknown.
Windmill at Kirkhouse Point, South Ronaldsay (Canmore ID: 9594)	Old windmill, Kirkhouse Point, 18th century. The solid conical stone base of a post mill.
Wind pump at Berriedale, South Ronaldsay (Canmore ID: 192148)	Wind pump recorded in 2010. Survival and condition unknown.
Windmill, Chinegar, Swanbister, Orphir, Mainland (Canmore ID: 1943)	Site of an 'amateur mill' erected in 1910. It consisted of a wooden superstructure and four sails, with power transmission to the mill. It worked until 1939.
Windmill at Villasquoy, Ireland, Mainland (Canmore ID: 2078)	Parish records note the presence of a windmill, but the site could not be located in 2009.
Beboran, Harray, Mainland (Canmore ID: 144850)	Location of wind pump, condition and survival unknown.

Wind pump at Ness Farm, Tankerness, Mainland (Canmore ID: 2993)	Mid-19th century farm steading with wind-powered water pump to NW of farmhouse. The wind pump is a framed tripod supporting steel sails in circular arrangement; wind-direction paddle from centre; rectangular water tank raised on concrete support adjacent to N. The wind pump is manufactured by Climax, of Horsham, Surrey, as were several other, basically identical pumps on the mainland. It was installed by the Army in the early 1940s at Holm, also on the mainland, where a large Army supply depot was located. The wind pump supplied water for the site. It was dismantled and rebuilt at the present site in the early 1950s, replacing a hand pump which was the previous method of water supply at the Ness. The upper mechanism consists of 18 sheet metal sails (reduced in length from the original) and a fan tail just over a meter long. A timber pump rod (now missing) was housed by the tapered metal frame and caused water to be delivered to the pressed steel tank flanking it. Very few wind pumps survive in Orkney, often having been dismantled when settlements were connected to a mains water supply.
Wind pump at Loch of Tankerness, Mainland (Canmore ID: 2983)	The masonry filter house and pump room was built in the late 19th century when the pump was powered by an oil engine. The wind pump replaced the oil engine in the early 1940s.
Wind pump at Laith, Harray, Mainland (Canmore ID: 1655)	This windpump was installed in 1952 and was in use until 1967. It pumped water from a spring up to a 3000-gallon storage tank and was used for domestic and farm water supply. When it was installed, this 'Climax' unit was already second-hand.
Wind pump at Ness of Tenston, Harray, Mainland (Canmore ID: 1656)	These are the remains of a 'Climax' wind pump which originally had 18 sails with an overall diameter of 1.76m. The pump was used to supply water to a dwelling and farm. The windpump was rendered obsolete when the mains water supply was connected in the late 1960s/ early 1970s.
Windpump at Redland, Sandwick, Mainland (Canmore ID: 1750)	This is a Newark windmill and pump (model/makers number 1468) no longer has its sails.
Wind pump at Millhouse, Holm, Mainland (Canmore ID: 2383)	This pump was installed as new in 1943 over a natural spring. It was damaged in a storm in 1953 and damaged again in the mid-1950s. It was then replaced with an electric pump. The windpump supplied water for several dwellings and a farm. It was made by Climax, Horsham, Surrey.
The Links, Pierowall, Westray (Canmore ID: 2791)	Remains of a wind powered threshing machine recorded at The Links.
Threshing mill, Sanquhar, Westray (Canmore ID: 3232)	Remains of the stump of a wind powered threshing machine.
Helzie, Rapness, Westray (Canmore ID: 3231)	Remains of a windmill stump.
Skelwick, Hillhouse, Westray (Canmore ID: 2818)	Location of windmill, condition and survival unknown.
Swartaback, Rapness, Westray (Canmore ID: 2817)	Location of windmill, condition and survival unknown.
Post mill at Holland Farm, Papa Westray (Canmore ID: 2869)	In an elevated field south of Holland is the circular stone base of a dismantled post-mill said to date from the early nineteenth century and to have been in use until around 1940.
Windmill at Holland, Papa Westray (Canmore ID: 296982)	A square platform of bonded masonry stands to a height of 1.75m. A stairway, set into the east side, leads to the top of the platform. This is level and incorporates a large flat slab which has an off-centre hole cut into it. The base of the platform is dilapidated and has begun to collapse.
Threshing mill, Mayback, Papa Westray (Canmore ID: 2872)	An industrial windmill with an engine and threshing machine was previously recorded at this location but could not be relocated during surveys in 1998.
Threshing mill, Roadside, Papa Westray (Canmore ID: 2873)	An industrial windmill with an engine and threshing machine was previously recorded at this location but could not be relocated during surveys in 1998.
Threshing mill, North Via, Papa Westray (Canmore ID: 2874)	An industrial windmill with an engine and threshing machine were recorded here in the past but could not be relocated during surveys in 1998.
Threshing mill, South Via, Papa Westray (Canmore ID: 2875)	An industrial windmill with an engine and threshing machine were recorded here in the past but could not be relocated during surveys in 1998.

Threshing mill, Gowrie, Papa Westray (Canmore ID: 2876)	An industrial windmill with an engine and threshing machine were recorded here in the past but could not be relocated during surveys in 1998.
Wind engine at Hookin, Papa Westray (Canmore ID: 2870)	An industrial windmill with an engine was recorded here in the past but could not be relocated during surveys in 1998.
Wind pump at Aikerness, Westray (Canmore ID: 98015)	This is a complete Newark windmill and pump. Installed in 1946 by a spring, it pumped water to a 2000 gallon storage tank for use in a farm house and outbuildings, as well as being used for irrigation. The windmill and pump became redundant in the 1960s when Westray was connected to mains water.
Wind pump at Melsetter, Hill Head, Hoy (Canmore ID: 179947)	Location of wind pump, condition and survival unknown.

WATER / HYDRO POWER



Top: Click Mill (© Gareth Talbot, ORCA), Bottom left: Russland Mill (© Canmore 1653), Bottom right: Finstown watermill (© Canmore 2085)

The use of water to power mills goes back centuries, and Orkney has a wealth of watermills, some of which are still operational (such as the Barony Mill near Birsay) and some of which are unique (such as the Click Mill near Dounby). The majority of watermills recorded in Orkney date to the 18th and 19th centuries, although there is a possible Norse-period horizontal mill at Earl's Bu in Orphir. This all demonstrates a long history of watermill use in Orkney and while there is less by way of hydropower generation in the present day, it does suggest that there could be the potential to harness hydropower in the future, particularly in relation to microrenewables.

Site	Description
Click Mill, Dounby, Mainland (Canmore ID: 2269)	This mill is the only surviving example of a horizontal water mill in Orkney, and it has been excellently restored with all its machinery in working order and its flagstone roof intact. It was built around 1823 to replace an older mill in the same place Millbrig, and it was used throughout most of the rest of that century; it has been necessary to engineer a piped supply of water so that the restored mill can operate for about 8 minutes at a time, because the original water supply was destroyed by quarrying in the burn for stones for road making in the 1920s.
Boardhouse Mills, New Mill, Birsay, Mainland (Canmore ID: 1783)	The site is restored (in 2010) and is now known as Barony Mill. The Boardhouse Mills consist of three mills, 2 of which are corn mills, and the third a threshing mill. The New Barony corn mill is still in use, and consists of a massive 3 storey rubble structure, including a kiln with a fixed square ventilator. The mill dates from 1873, whilst the neighbouring mills are considerably older, possibly dating back to the 18th century. Bere and oatmeal are still produced by the new mill, which continues to employ its waterwheel (overshot, cast iron, approx. 430cm in diameter driving 3 pairs of millstones and full complement of machinery) as the major source of power.
Mill of Harray, Russland Road, Conyar, Mainland (Canmore ID: 1653)	Mill of Harray, 18th to 19th century, converted to dwellings in 1999. The waterwheel buckets have been re-instated into the skeleton of the original wheel. The surviving mill machinery has been incorporated into the garden as sculpture. The original (replacement) concrete lade is in a good state of repair. The louvered vent has been removed and the site re-roofed.
Sabiston Mill, Dounby, Mainland (Canmore ID: 1891)	This 19th century, two-storey, stone-built grain mill is disused. It has lost its prominent revolving ventilator based on a short octagonal column and its lade feeding the (unusual for Orkney) low breast waterwheel.
Kirbister Mill, Mainland (Canmore ID: 1946)	Kirbister Mill, 18th century, disused. A large 3-storey and attic flagstone rubble range on a T plan, with a lean-to wheelhouse.
Horizontal mill at Earl's Bu, Orphir, Mainland (Canmore ID: 1968)	The remains of a possible Norse period horizontal mill.
Finstown Mill, Mainland (Canmore ID: 2085)	This fine example of an Orkney Mill consists of a large 19th century two storey, rubble block, built on an 'L' plan, with a flagstone floor
Tormiston Mill, Stenness, Mainland (Canmore ID: 2150)	Tormiston Mill is a good late example of an early to mid-19th century a Scottish water powered grain mill.
Helicliff Mill, Woodwick, Evie, Mainland (Canmore ID: 2238)	19th century. A 2-storey and basement rubble range on an L plan, with two pairs of stones driven by an overshot wheel 3ft 6ins (1.06m) wide by 14ft (4.26m) diameter, with rim drive. Disused but intact.
Sebay Mill, Toab, Mainland (Canmore ID: 3055)	This mainly 19th-century rubble-built mill was driven by the water taken from the Burn of Langskail. The mill complex consisted of a slate roofed main building and kiln, and a 2-storey flat-roof engine house. This mill has been converted to self-catering accommodation.
Grain Mill, Millhouse, Isbister, Mainland (Canmore ID: 144876)	This grain or corn mill was in use until the 1940s. The machinery and waterwheel were removed in the 1950s.
Papdale Mill, Mill Street, Kirkwall, Mainland (Canmore ID: 144951)	Rebuilt 1880 by architect T L Peace. A large rubble building on an L plan, now a joiner's shop. The pyramidal-roofed kiln has been converted into an office.
Mill of Rango, Sandwick, Mainland (Canmore ID: 149711)	19th century. A rectangular rubble range, with the site of an overshot wheel. The most striking feature is a large pyramidal-roofed kiln.
Farm Mill, Ireland, Mainland (Canmore ID: 153344)	19th century mill and dam.
Mill of Voy, Stromness, Mainland (Canmore ID: 155700)	19th century. The roofless ruin of a complex block of rubble buildings, with the skeleton only of a low-breast iron wheel which had iron buckets.
Netwermill, Sourin, Rousay (Canmore ID: 2734)	19th century. A three-storey rubble building, harled on the main frontage, with an eight-spoke overshot wood and iron wheel. The lade is carried on a drystone wall.
Peckhole Meal Mill, North Ronaldsay (Canmore ID: 169290)	Peckhole Mills, 18th to 19th century. The watermill here is a rectangular two-storey rubble building, with a single-storey lean-to extension. The kiln vent is unusually large. Nearby is the conical stone base of a tower windmill

Hooking, North Ronaldsay (Canmore ID: 169264)	Early 19th century watermill, listed in 1999 as having 'remnants of flagstone and turf-thatched roof'.
Boloquoy Mill, Sanday (Canmore ID: 3445)	18th to 19th century. A small rectangular 2-storey rubble building, with an 8-spoke, wood and iron low-breast wheel.
Westove, Scar, Sanday (Canmore ID: 256351)	Location and condition of watermill unknown.
Mill of Hoy, Nether Linksness, Hoy (Canmore ID: 1588)	Remains of a water-powered grain mill.
Risa Mill, Hoy (Canmore ID: 8930)	Water-powered grain mill.
Newstead, Quoyness, Hoy (Canmore ID: 163350)	Later to late 19th century with alter alterations. Single storey, 3-bay, symmetrical, rectangular-plan cottage, with former mill complex (now derelict)
Stronsay Meal Mill (Canmore ID: 3306)	Stronsay Mill, Millfield, 19th century. A 3-storey rubble building with an overshot wheel in a roofless house.

PEAT



Top: Man moving Peat by Flotta oil terminal (© Flotta Heritage Trust), Bottom: Cutting peats in the 19th century (Lee & Irvine, 2022 / Orkney Library & Archive)

Peat and turf have been used for fuel in Orkney since at least the Neolithic period and was the main source of domestic fuel during the medieval and much of the post-medieval period (Fenton 1997). Today peat is still burnt for heat on a small, local, scale, and during prehistory and into the early and later medieval periods, this would have been the same, using the resource in an as-needed basis, using nearby sources. Across the islands is evidence for peat cutting, an activity that has likely been undertaken since prehistory, and with some small-scale extraction continuing to the present day for personal use, and for use in the making of whisky.

In Eday, which has extensive peat cover, a larger-scale commercial operation was in place from 1926 until 1965, which saw peat being dug and exported across Orkney and to mainland Scotland. The remains of this industry are present in the form of surviving parts of the Eday Peat Company railway which was built to transport peats from the interior of Eday to the coast for loading onto boats for export.

In Mainland Orkney, the Highland Park distillery has been cutting peats every April for many years and continues to do so to the present day.

Site	Description
Eday Peat Railway (Canmore ID: 373866)	Eday peat has long been a valuable resource, and the main supplier of peat to Orkney. Within Eday are the preserved remains of the Eday Peat railway, where peat was landed for onward transport across Orkney and to Edinburgh. The railway was used to transfer peats to boats from a stone-built pier. There are remains of a short cutting from the shore edge with two sets of parallel iron rails in the base, with the remains of a wagon nearby. The pier has completely vanished. This previously unrecorded site was established in 1925 by the Carrick Estate for the export and sale of peats, mostly to distilleries. The venture ended after the Second World War.
Hobbister, Mainland (Canmore ID: 296149)	The Highland Park whisky distillery extracts peat for its operations at Hobbister.

HISTORIC GAS

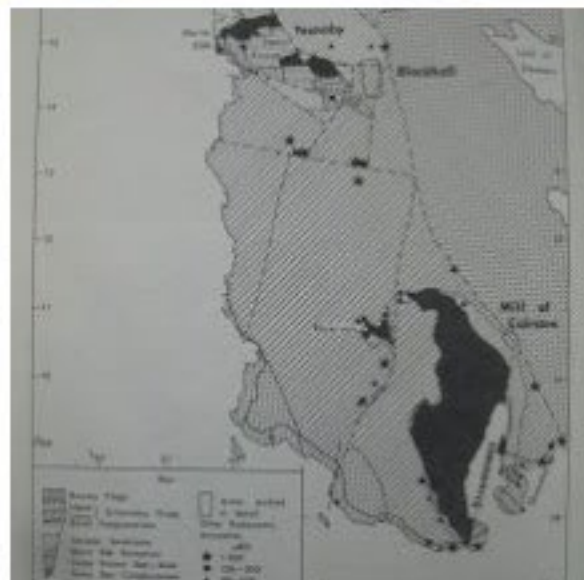


Left: Gas streetlight, Stromness (© Dan Lee, ORCA), Top right: Stromness gasworks (© Canmore 1496), Bottom right: Kirkwall gasworks (© Canmore 110946)

Coal gasworks were once universal in Scottish towns and villages, and Stromness and Kirkwall were no different. Both gasworks were closed by the 1970s, and would have been prominent presences within the towns, both from a visual and odorous perspective.

Site	Description
Former Kirkwall Gasworks, Mainland (Canmore ID: 110946)	<p>Gas works, 19th and early 20th century. A group of corrugated-iron and rubble buildings, dominated by a corrugated-iron-clad vertical-retort house. There is a small 6-column holder, and a range of purifiers, water-cooled condenser and scrubber also survive.</p> <p>This site is now occupied by 1980s housing and is now known as 'Castleyards'.</p>
Former Stromness Gasworks, Mainland (Canmore ID: 1496)	<p>This former gasworks is now a workshop with associated storage buildings. The retort house (where coal/coke was burnt to produce gas and by-products for lighting, cooking and so on) survives and consists of a rubble-built building with upper parts of the wall rebuilt with brick around 1953, when the retort house roof structure was replaced. It has a square, rubble-built chimney.</p> <p>By 1902 (Ordnance Survey second edition 25-inch map, Orkney, 1902, sheet CVI.11), the site has been added to presumably to increase gas production capacity for the town. The buildings covered an area of about 484 square metres in a plot measuring approximately 2150 square metres. This gasworks was sited to the N extent of Stromness due to the unpleasant odours produced by making town gas and the threat of explosion.</p>
Gas lighting	<p>Examples of gas streetlights in Kirkwall and Stromness (e.g. top of Springfield Crescent, Stromness). Exact numbers and locations of these are not currently known, and a study of them would be beneficial.</p>

URANIUM



Top: Peter Maxwell Davies *Yellow Cake Remembered* (The Orkney News 25/07/2020), Bottom left: Sign in Stromness designed by Ian MacInnes (credit Harald Kucharek, The Orkney News 25/07/2020), Bottom right: map of uranium deposits north of Stromness (Lee & Irvine, 2023)

While uranium was never mined in Orkney, the potential that it *might* have been has left a lasting historical legacy for those involved in the initial explorations and those in opposition who aimed to stop it happening. There is no real physical 'site' as such relating to uranium exploration, although of course the uranium ores remain present under the West Mainland ground surface, along the 'uranium corridor' between Yesnaby and Stromness. There is also a wealth of material relating to the initial explorations, through to the anti-uranium campaigns including documentary, photographic, artistic (both written and graphic) and film material; all of which will be a critical part of the Orkney Energy archive.

RENEWABLE ENERGY TEST SITES AND DEVICES



Top: Orbital O2 at Fall of Warness test site, Bottom left: Pelamis P2 at Billia Croo test site, Bottom right: Billia Croo onshore facility (all images © EMEC)

From a review of energy test sites and devices, Orkney is in a position where it is drawing on its impressive history of harnessing the power of the elements to produce energy and amplifying them to solve the myriad of energy challenges we are facing today.

The global hub of renewable energy research and development is in Orkney, with the European Marine Energy Centre (EMEC) running a number of test sites for tidal and wave energy generation experiments. EMEC operations are spread over four sites across Orkney, and these are outlined in the table below.

Site	Description
Testing sites	
Billia Croo Grid Connected Wave Test Site	<p>Consists of five cabled test berths in up to 70 metres water depth, located approx. 2km offshore and 0.5km apart.</p> <p>Five 11kv subsea cables feed into the EMEC substation which houses the main switchgear, backup gen and comms rooms, and was carefully designed to minimise visual impact.</p> <p>The cables feed the electricity generated by the wave energy converters testing on site directly into the National Grid.</p> <p>The test site berths are monitored by CCTV located at the EMEC observation point at the Black Craig, a former Coastguard lookout station.</p> <p>URL: https://www.emec.org.uk/facilities/wave-test-site/</p>
Fall of Warness Grid Connected Tidal Test Site	<p>Situated just west of Eday, in a narrow channel between the Westray Firth and Stronsay Firth.</p> <p>Seven cabled tidal test berths at depths ranging from 12m to 50m in an area 2km across and approx. 4km in length.</p> <p>The 11kv subsea cables feed into EMEC's substation on Caldale in Eday which houses the main switchgear, backup gen and comms room. The substation controls the supply from each tidal device and connection to the national grid.</p> <p>An adjacent laydown area offers developers the opportunity to use conditioning equipment for converting electricity from the level at which it is generated to grid compliant electricity.</p> <p>URL: https://www.emec.org.uk/facilities/tidal-test-site/</p>
Scapa Flow Scale Wave Test Site	<p>Non-grid connected site, offers real-sea testing in less challenging conditions to provide a more flexible sea space and acting as stepping-stones towards larger scale projects.</p> <p>URL: https://www.emec.org.uk/facilities/scale-test-sites/</p>
Shapinsay Sound Tidal Test Site	<p>Non-grid connected site, offers real-sea testing in less challenging conditions to provide a more flexible sea space and acting as stepping-stones towards larger scale projects.:</p> <p>URL: https://www.emec.org.uk/facilities/scale-test-sites/</p>
Devices / Models	
Pelamis, Lyness pier, Hoy	<p>The Pelamis P2 wave energy converter is moored at Lyness pier on Hoy. The P2 is 180 m long, weights 1300 tonnes and is rated at 750 Kw. It was the world's first commercial scale marine device to generate electricity to the grid, from offshore. The power was created from flexible joints that are linked to cylinders that pump liquid into high pressure accumulators to generate electricity.</p> <p>A nose cone from the P2 is also in place at a playground in Moaness, Hoy.</p> <p>The future of this world's first device is in doubt, and it is understood that it is due to be dismantled and recycled in the near future.</p>
1:10 scale Pelamis	TBC
LS1 blade	TBC
Baby Penguin	TBC
SR250 blade	TBC
Andritz turbine	TBC

WINDFARMS AND TURBINES



Top: Wind turbines at Inganess (© Gareth Talbot, ORCA), Bottom left: Flotta wind turbine (© Gareth Talbot, ORCA), Bottom right: Bugar Hill windfarm (© Canmore 298128)

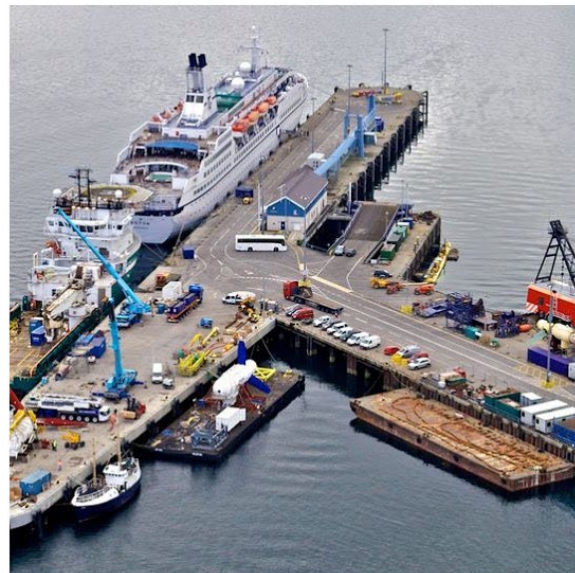
The pioneering development of wind power electricity generation started in the 1950s at Costa Head in the West Mainland. Since then, Orkney has seen the construction of an experimental windfarm at Bugar Hill, as well as a number of windfarms, individual community owned and operated wind turbines, and privately owned and operated turbines ranging from large to small scale.

As with the rest of Scotland, the presence of wind turbines within the landscape is now relatively ubiquitous, and a list of operational wind farms, community turbines and individual turbines is provided below. This list does not include smaller privately owned turbines which according to the OREF database² numbers 500+ in Orkney.

² <https://www.oref.co.uk/resources/microgenerator-database-results/> [accessed 19/06/23]

Site	Description
Burgar Hill, Mainland	Contains 6 turbines: 1 Enercon E70/2300, 2 Nordex N80/2500 and 3 others, with a combined nominal capacity of 11 MW. It was commissioned in several stages, from 2000 to 2011. The NM92 wind turbine on Burgar Hill turned 100,000,000 kilowatt-hours (kwh) in April 2015. It is the first single wind turbine in the UK to have reached that milestone.
Hammars Hill, Mainland	Constructed in 2010. The project uses the Enercon E44 900kW wind turbine, and an annual production of 20,000 MWh from a five-turbine windfarm of this scale is a capacity factor greater than 50%.
Rennibister, Mainland	A single turbine located between Kirkwall and Finstown on the West Mainland.
Westray community	Owned by Westray Renewable Energy Trust on behalf of the people of Westray. All surplus revenue is donated to Westray Development Trust to finance community projects through the Turbine Fund.
Eday community	A single 900kw turbine, income from which is reinvested into Eday.
Hoy community	A single 900kw turbine, income from which is reinvested into Hoy.
Rousay community	A single 900 kW community-owned wind turbine on Kingarly Hill which started generating renewable energy in October 2011. The income from this project is gifted back to the Development Trust to be used on the development of projects for community benefit and for the funding of the Grants and Bursaries Funds
Stronsay community	A single 900kw turbine, income from which is reinvested into Stronsay.
Shapinsay community	Operational since 2011, Shapinsay Renewables Ltd (SRL) is the trading company for the 900 kW wind turbine and is wholly owned by Shapinsay Development Trust (SDT). SRL operates the turbine with the purpose of passing the profit generated to SDT for the benefit of the community of Shapinsay.
Burray Northfield	The Burray turbine began generating in 2005. The turbine is one of the most productive machines of its size in the world; total electricity production between 2005 and the end of 2017 exceeded 40,000 MWh.
Flotta	A single 2.3MW turbine brought online in June 2010. It is connected to the National Grid.
Spurness, Sanday	Operated by SSE Renewables, Spurness wind farm was repowered in 2012 where the original three turbines were decommissioned and replaced with five newer models. Spurness now provides power for around 12,000 homes.
Microgenerators	There are over 500 privately owned and operated micro wind generators across Orkney, as identified in the OREF microgenerator database.

HYDROGEN

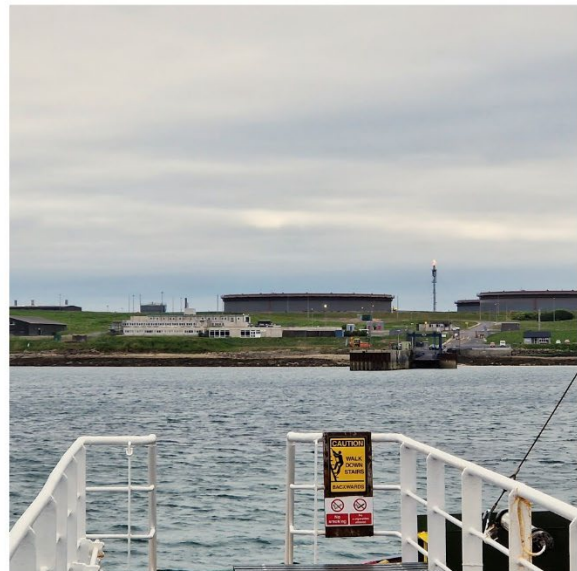


Top: EMEC hydrogen refuelling point, Hatston (© Dan Lee, ORCA), Bottom left and right: mobile hydrogen refuelling facility and Kirkwall harbour hydrogen refuelling facility (both © EMEC)

EMEC operates a hydrogen research & development system based in Orkney comprising both fixed and re-deployable hydrogen production assets, facilities for hydrogen transportation and refuelling, fuel cells and a demonstration combined heat and power plant at Kirkwall Airport.

Site	Description
Eday	<p>Electrolyser and static storage hydrogen production plant including a 670 kW rapid response PEM (Proton Exchange Membrane) electrolyser which produces hydrogen using locally-produced renewable energy. The asset is housed in an ISO container and has the capability of generating up to 260 kg of high purity, fuel cell grade hydrogen per day.</p> <p>Adjacent to the electrolyser is EMEC's energy storage building that houses 48 vanadium flow battery modules with a combined storage capacity of 1.8 MWh.</p>
Re-deployable assets	<p>A re-deployable modular electrolyser which can used for on-site small scale hydrogen generation in locations with no fixed production infrastructure.</p> <p>Housed in a container, the unit consists of 10 stack anion exchange membrane (AEM) electrolyser technology and a low-pressure buffer tank. The electrolyser is rated at 24kW and generates hydrogen at 30 – 35 bar which is then stored in the low-pressure buffer tank.</p> <p>Mobile storage trailers that transport hydrogen from point of production via road and ferry to a variety of end applications across power, heat and transport in technology demonstration projects. The trailers consist of 59 lightweight composite cylinders made of aluminium with a Kevlar wrap.</p> <p>Mobile refuelling facility that provides hydrogen refuelling capabilities to locations with no existing or fixed hydrogen infrastructure.</p>
Kirkwall Pier	<p>A 75 kW fuel cell housed at the pier which can convert hydrogen back to electricity. The electricity can then be used to 'cold iron' inter-island ferries while berthed overnight at the pier.</p>
Kirkwall Airport	<p>A combined heat and power unit installed at Kirkwall Airport to demonstrate the use of hydrogen for heat and power requirements in the airport terminal building. Once fully commissioned, the unit will be operated and maintained by EMEC.</p>
Eday	<p>Hydrogen 670kW electrolyser facility</p>

OIL



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The oil boom in the 1970s led to the construction of the Flotta oil terminal, which still receives North Sea crude oil, shipping this around the world.

Kirkwall power station, opened in 1951, was a diesel oil powered power plant operated by Scottish and Southern Electricity, with a total output of 16 MW. It is worth noting that in 2013 the power station was the test home for the UK's first large-scale battery that was connected to Orkney's electricity distribution network. The trial investigated how large-scale batteries could effectively store excess renewable energy.³

In addition to the oil terminal, there is evidence across Orkney for refuelling pumps within garages, and individual refuelling points on the islands, usually associated with independent

³ <https://www.sse.com/news-and-views/2013/08/uks-first-grid-battery-is-powered-up-on-orkney/> [accessed 29/06/23]

garages or local shops. Some of these pumps are of early designs and represent an important surviving part of Orkney's recent past.

Site	Description
Flotta Oil Terminal	Construction of the Flotta oil pipeline terminal commenced in 1974 and was opened in 1977. The terminal occupies a 160 ha site in the northern part of Flotta between an inlet known as Pan Hope and the northern shore.
Kirkwall Power Station	Opened in 1951, constructed by Orkney Builders using local stone and reclaiming land from the Peedie Sea, it was powered by diesel oil.
Petrol pumps	Located across Orkney, some of which are of early date and design (e.g. Balfour, Shapinsay).