Orkney Cloud

Community-led data services

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Orkney
North Ronaldsay
Papa Westray
Noup Head
Pierowall
Westray
Sanday
Kettletoft
Rousay
Egilsay
Eday
Whitehall
Brough of Birsay
Wyre
Burgar Hill
Broch of Gurness
Gairsay
Dounby
Mainland Orkney
Stronsay
Skara Brae
Shapinsay
Balfour
Auskerry
Ring of Brodgar
Yesnaby
Ness of Brodgar
Hatston
Finstown
St Magnus Cathedral
Maeshowe
Mull Head
Stromness
Stones of Stenness
Kirkwall
Wideford Hill
The Gloup
Keelylang
Kirkwall Airport
Hoy
Houton
Graemsay
St Mary's
Scapa Flow
Old Man of Hoy
Rackwick
Fara
Copinsay
Italian Chapel
Cava
Flotta
Burray
Lyness
South Ronaldsay
Longhope
St Margaret's Hope
Walls
Swona
Tomb of the Eagles
Burwick

'What is the Orkney Cloud?'

Orkney is a group of islands off the north east coast of Scotland, apparently at the margins of Europe. Yet in terms of green energy, they are on the frontline. The islands are a global leader in wave and tide energy, hydrogen fuel, smart grids, and community-led innovation. However, the islands remain at the edge of the internet.

So, can we create community-led, cloud services at the edge – where the internet is thin, but the social networks are thick – and the environmental resource to power data processing is huge? Instead of distant, centralised data storage and processing, how might local cloud services support socialised, shared, and distributed data processing?

This was the question we began with in 2017, as a group of researchers, some local to Orkney (Aquatera), others distant (IT University of Copenhagen, University of Edinburgh, Mozilla). But then we spilled out over the archipelago in our search for a collective answer.

This magazine is our initial answer to, what could an Orkney Cloud be? It Is an anthology of Orkney Cloud incubated projects and inspirations; a weaving together of people and possibilities that could become an Orkney Cloud. And it is not comprehensive. At present, we have thirteen separate projects being incubated in the Orkney Cloud, services ranging from tourism to transport, from archaeology to addressing fuel poverty.

We invited contributions from those who are building the Orkney Cloud, islanders who are already weaving energy and data networks together, to explain their projects and share their futures.

Within these pages an Orkney Cloud is explored as both technology and experience. There are more technical articles ('Orkney Cloud Data Centre' by Philippe Bonnet), more social articles about the role of community ('An Orkney Way' by Gareth Davies), artworks that create possibilities, a science fiction short story, and ongoing projects (such as 'A Day in the Life of an Islands' ISP' on the LoRA network by CloudNet).

So, what did we do in this first year, you might wonder? We knew we had to be community-led, which meant we needed to not just listen, but create a forum and community for us to collaborate with. Building this islands framework, making a data services community exist, was the important work we undertook.

We are incredibly grateful to our authors for taking their valuable time to write and craft their words. We only wish we could have included more. Warm thanks, too, to our new friends in Mozilla, who did not just fund this initial research, but have been unwavering in their enthusiasm and shared learning – companies can be archipelagos at the edge, too.

Orkney Cloud is a collaboration of diverse experts, and we are just finding out what we might do together. We believe that the lessons learned in this Orkney Cloud are relevant to similar edge communities worldwide. So we invite you to our stormy edge, to experience our many community-led data services that are just beginning...

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‘Orkney... is a global leader in energy generation... through a decentralized operating model that is entirely community based and community driven.’

David Bryant, Mozilla.

4 **Yesnaby waves** photo: Iain Ashman

connections

The Orkney Cloud Project and Mozilla

DAVID BRYANT

Hopefully you have heard of Mozilla, the global, non-profit, community-oriented organization driven by a mission to keep the internet open and accessible to all. Perhaps you may be more familiar with Firefox, our browser built from the ground up to be fast, protect your privacy online, and support Mozilla's mission. You may not have expected something from Mozilla to be part of this magazine about the Orkney Cloud Project, but there's a story to tell that begins with a bit of serendipity and unfolds to reveal many strong, shared common interests.

An important part of Mozilla's pursuit of its mission is recognizing that we're far more successful keeping the web open, healthy and accessible to everyone when we can partner with others. As part of that, each year we provide research grants to universities, labs, and research-focused non-profits to fund proposals suggesting how we might improve technologies or answer difficult questions impacting the open web. Each six months we put out a call for ideas, then review in detail what is generally more than a hundred thoughtful, impressively creative submissions. Each round can only fund around six to eight recipients so the review process is challenging and, for the submitters, a bit nerve-wracking.

In the second half of 2017 one of those proposals was for something called 'the Orkney Cloud Project'. From the outset it made a big impression on the grant proposal review team at Mozilla, of which I was a part. I think it's fair to say few of us knew much about Orkney and I don't believe any had ever visited. The gist of the proposal, though, was direct and stunning. Orkney, it observed, is a global leader in energy generation and produces substantially more power than it consumes. It does so through a decentralized operating model that is entirely community based and community driven. That overall approach was sufficiently well-established in Orkney that it seemed entirely plausible it could also work to provide data and internet services to everyone on Orkney, just as it provided electricity.

Moreover, the proposal observed, providers of cloud data services were increasingly realizing they were much better served economically by building data network centers where power was abundant and network connectivity less advanced, than what they had historically done in building their data centers near the large markets they served but unfortunately far away from sources of abundant power. Orkney, as it happens, not only has an abundance of power but also happens to lie on and be directly connected to the undersea cable that provides the transatlantic backbone of the internet. If you took two maps of the world, one which highlighted where energy was abundant and one that showed where connectivity was abundant, and laid them over the top of each other, you couldn't help but notice that Orkney shone through.

To be fair, the Orkney Cloud Project proposal didn't propose to build such a decentralized

cloud infrastructure. It wasn't even sure such a thing could be done successfully. What it did do, though, was offer a practical approach for re-examining the Orkney community model that had proven so successful for energy to see how it might be reused to apply to providing internet cloud services. The end result of that work would be, by the end of 2018, a lot of documented practical project ideas for next steps, and this magazine.

For Mozilla, this idea was compelling. A vital part of our mission, and our work every day, is figuring out how to better bring the open internet to people and give them the ability to use it beneficially in their daily lives. Much of that happens, not through what we do centrally with our employees, but instead what our over ten thousand community volunteers accomplish in their home countries and neighborhoods. Orkney seemed the ideal place to pioneer community approaches to delivering cloud services and package them up in such a way that they could be applied broadly around the world. While few other places might have the energy or connectivity abundance of Orkney, they could certainly take advantage of proven ways people could come together to define and operate their own local data services, and then actively engage whatever business and government partnerships were possible in their area. We enthusiastically approved funding the Orkney Cloud Project through a Mozilla Research Grant, and I was asked to serve as liaison between Mozilla and the Orkney Cloud Project team.

Coming to Orkney

As liaison, my role was to connect the Orkney Cloud Project team with any other part of Mozilla that might advise the overall Project effort, and to help make sure the Project team was best able to complete the grant-funded work they'd proposed to do. Other articles here talk about the core of that work. The intent of the Project wasn't just a theoretical description of a possible Orkney Cloud but one that could meet real needs of the people of Orkney and leverage Orkney advantages in the process. That meant clarifying what those needs might be and what sorts of ongoing benefits were desired in order to make an Orkney Cloud worth sustaining off into the indefinite future.

To that end in late February 2018 the Orkney Cloud Forum was established, made up of volunteer participants from the community, interested local companies, and technology providers who could contribute to building the shared and personal infrastructure. The Project






Project team visit and Orkney Cloud workshop
photos: Duncan Clarke, David Bryant

Stromness waterfront photo: Iain Ashman

team and Cloud Forum then set about identifying possible data and internet-based services that could meet the needs of people in Orkney, and scheduled a day-long workshop in April 2018 to collectively explore each idea. An open discussion of those ideas among people who might benefit, people who might build them, and those with relevant experience from Orkney's decentralized approach to power would certainly help shape the balance of the Orkney Cloud Project's 2018 work and also give me a great opportunity to derive first-hand insights into just how Orkney's community model worked. And it would give me a chance to explore Orkney, meet its people, and get to know the Project team better.

In April, then, I spent a week in Orkney. Much of the trip was spent coming to better understand the existing data services infrastructure on Orkney through meetings and site visits with those service providers. We also spent some time seeing key elements of the established energy infrastructure, including both wind turbine installations and power delivery to residences and public facilities such as electric car charge points. Several meetings explored the relationship to power generation in Orkney with how energy was managed in Scotland and the UK, which represented both opportunities and challenges in equal parts technical and commercial, all potentially likely to impact the successful creation of a distributed Orkney Cloud. We also talked with some local experts on what data services might be useful, ranging from monitoring livestock to gathering environmental data through wireless sensors installed on inter-island ferries. Happily there was some time to sightsee and get to know Mainland better as well as talk with local residents about life in Orkney.

The Cloud Forum workshop itself in the middle of that visit week explored a wide range of possible data and cloud service projects, primarily emphasizing those that would benefit the citizens of Orkney in some meaningful way. Unlike experiences I have had at similar community events elsewhere, I was profoundly struck by the degree of independence and empowerment the workshop attendees expressed. As each topic was discussed the conversation centered on what could be done, how it might benefit participants, what challenges would be faced, and how practical the implementation would be. There was never a gating sense of whether permission could be obtained, what bureaucracy constraints might be imposed, or which influential person or agency needed to be influenced. That impression led me to questions I explored during the remainder of the visit, and helped me better understand Orkney and why it struck me as so similar to Mozilla.

At the end of the week we all had a much clearer idea what the Orkney Cloud Project could undertake, what we needed to work on, and where the various participants could contribute.

Post-visit insights

One kind of takeaway from the week spent in Orkney was an identification of technology areas where external expertise could help inform Cloud Forum members as to what might be possible. An example of that arose from conversation at the April workshop about the challenge of getting from island to island to take part in community efforts or public meetings. Several workshop participants lamented the time and complexity

introduced by needing to get around through a combination of car and ferry when all they really wanted to do was be part of a meeting with other residents. Organizing working meetings across a geographically distributed group of participants is an everyday occurrence at Mozilla. Our workforce is scattered across nearly thirty countries around the world and there is no central corporate headquarters. Instead, over the years, Mozilla and its teams have figured out how to do our work and run our business through meetings that take place almost entirely online, allowing remote worker participation from pretty much anywhere and on nearly any computer or mobile device.

I volunteered as an action coming out of the April workshop to host a follow-up conversation about how we handle remote-centric meetings at Mozilla. Naturally we used our own online video meeting technology to enable that session and had participants from the US, Denmark, Scotland, the Canary Islands and, of course, Orkney. This is a good example of how our existing technology could be applied through an Orkney Cloud platform to provide value for the residents of Orkney, and businesses in Orkney too. The Orkney Cloud Project team hosted two other such workshops, one on the 'Internet of Things' approach for easily interconnecting sensors and devices, and one on building basic cloud data centers and services. (And we used remote meeting tools to host those workshops as well.)

More profound for me, though, was the deeper appreciation my visit provided of the Orkney way of doing things. Mozilla's enthusiasm for funding the Orkney Cloud Project was rooted in the tangible potential for developing best practices in building community-centric internet capabilities anywhere in the world. While what might work in providing an Orkney Cloud is important, how it came together has even greater potential impact. Though I've only spent one week in Orkney, I came away with three strong, relevant impressions.

First, as it was explained to me, the decentralized approach to energy generation in Orkney is built on a straightforward model. (This is not to say the extended system involved is not complicated. It is. But the general model is both innovative and direct.) As an example, consider how a wind turbine is deployed. A non-profit community entity such as a parish undertakes financing of the effort, which it can do as a legal entity. That financing is based on a business model in which costs of the turbine are recovered in only a part of its operating lifetime, with revenue generated during the rest of that lifetime then being available for reinvestment in the community. The non-profit does need to create enough of a business structure to handle the turbine project and operate it going forward, plus oversee handling of the proceeds to be reinvested. Community members have eagerly stepped into those roles, and this has happened broadly across Orkney. The abundance of energy in Orkney creates an opportunity for a community to create a business that can generate much-needed funds to invest in that community. In the process the community gets electricity to use. That such an approach thrives in Orkney, and could perhaps be extended to apply to providing data and cloud services in Orkney and elsewhere, is an exciting possibility and the overall operating model is a very important takeaway from the Orkney Cloud Project.

Houton Bay photo: Philippe Bonnet

This, by the way, is approximately the model we use at Mozilla, in which a non-profit foundation operates a business to build the products and lead the policy work it needs to fulfill its mission.

My second strong impression of Orkney was the impact and importance of community. Success and growth of the energy services in Orkney are due in large part to individuals who have served in volunteer roles in their local area or collectively across the archipelago. The great majority of participants at the April workshop were such people, many of whom have been active for years. Beyond the willingness of individuals to serve, though, I also saw how the operations' responsibilities I would normally have associated with businesses or local governments were handled by self-organizing committees of individuals who provided strong leadership and decision-making, and who engaged effectively with businesses and larger government bodies in Scotland and the UK. That collective experience came across as a solid understanding of how to get things done and a confidence they could get done. As a result, the April workshop was not at all about which of the identified efforts might be possible, but that they were all possible and it would come down to a practical cost/benefit analysis to decide which should move forward.

Thirdly, I was impressed by the way in which local businesses engaged to support community projects and community working groups. Unquestionably the existing Orkney energy landscape has been built by a variety of capable businesses who have been functionally and economically successful. Whatever shape the Orkney Cloud takes will similarly require businesses as foundational elements. Consistently, though, the business people I met with in Orkney had an approach that symmetrically reflected their strong community partners' efforts and accommodated those partners' needs. It was clear they viewed the project possibilities as collaborative opportunities and saw the benefits of engaging as peers with the individuals and committees from the community. Those business people were all still very much mindful of their own need to be successful, so understanding clearly how a community partnership approach aligns with their commercial aims will be vital in figuring out how to replicate the Orkney Cloud in environments where business conditions will be undoubtedly different.

What's next?

Mozilla's view of the Orkney Cloud Project is very much as a work in progress. As is often the case, major efforts like this come in a series of active phases over a period of several years and blend data-gathering, experimentation, implementation, and refinement. Certainly we at Mozilla will spend time with the Project team after this current phase has completed to translate lessons learned into practices we can begin implementing with Mozilla communities around the world. We are also keen to hear what the Orkney Community Forum and the Project team would like to undertake next and what opportunities for involvement that presents.

And while I'm sure there will be a great deal of enthusiasm for the specific services that could be created and the technologies useful in building them, the lessons learned in enabling an empowering community cloud in Orkney will teach us how to better provide an open, accessible internet for everyone, everywhere.

David Bryant is a fellow in Mozilla's Emerging Technologies organization, providing technical expertise and representation for engineering broadly in all aspects of company decision-making, paying particular attention to getting new technologies more rapidly into our platform and products.

futures

Developing sustainable futures – an Orkney Way

GARETH DAVIES

The islands of Orkney lie off the north coast of Scotland, between the Atlantic and the North Sea. They have an inspiring environment, rich wildlife, vibrant communities, a diverse economy and a fascinating propensity for innovation.

Orkney has made a number of special contributions to the history of social development. Many are recognised as being of national, international and even global significance - far greater than one might expect for an archipelago of 17 inhabited islands, home to around 20,000 people, in the north Atlantic.

This pedigree in pioneering innovation, technology application, creative activities, expansive thinking and successful community building has given Orkney an opportunity to play an important role in developing and delivering sustainable solutions that will meet the increasingly fraught challenges set before society on a global basis.

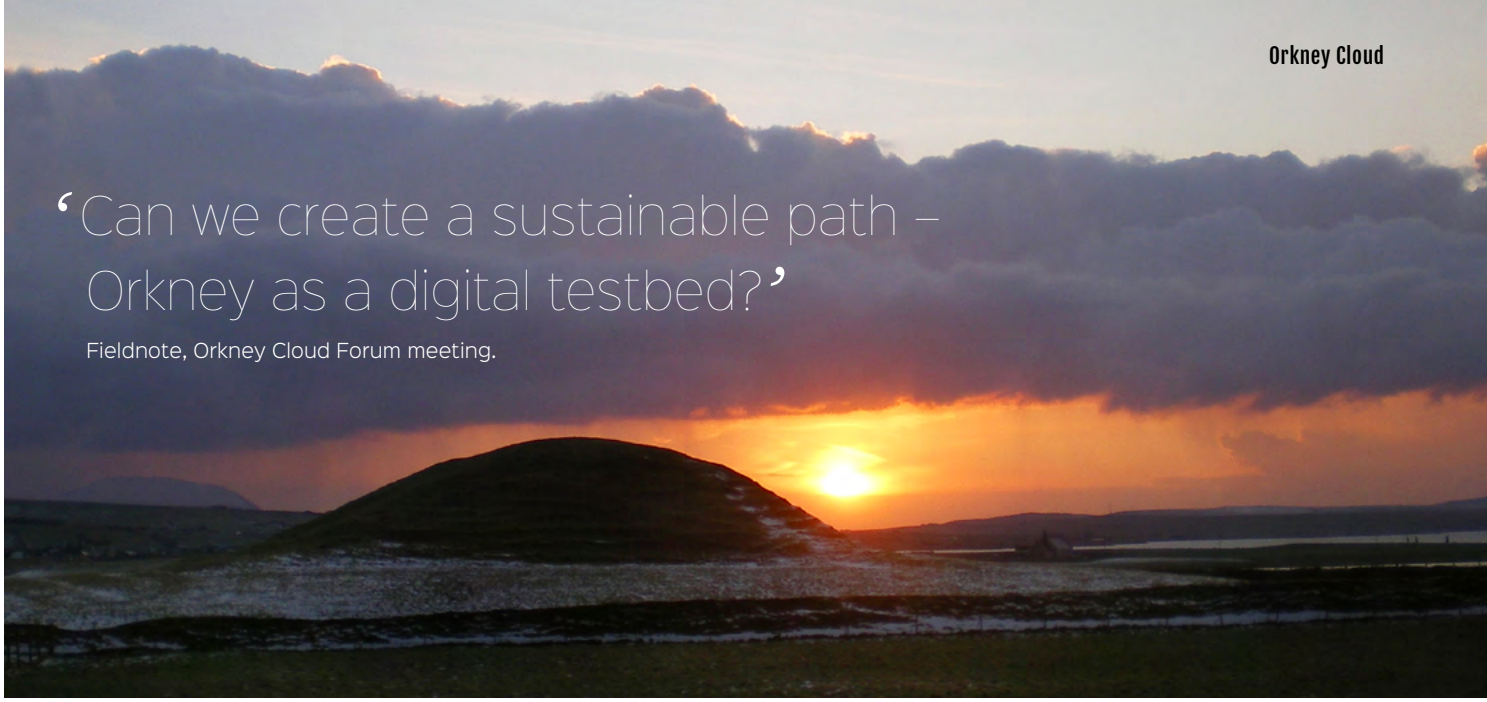
This article explores how these and other innovations happen in Orkney, based on a track record of achievement stretching back 5,000 years. It then considers, whether there could be an 'Orkney Way' that has facilitated such achievements. Finally, it considers whether such a 'Way' could help underpin the archipelago's credentials as a beacon for innovation and research under the theme of 'Orkney – the living laboratory'.

Over recent years in Orkney, sustainable energy has been one particular theme of exploration and innovation, whilst digital connectivity and capacity are also a growing focus. Consequently, the article considers - can Orkney do for digital connectivity what it has done for sustainable energy, and in doing so is there an 'Orkney Way'? Furthermore, could any 'Orkney Way' be used more widely to help other places achieve their own sustainable development goals?

Was there an 'Orkney Way'?

It is clear from the existing and growing archaeological evidence gathered across Orkney that in Neolithic times (around 5,000 years ago) the islands were home to creative, technologically adept, innovative, widely connected and, it seems, pioneering people. These early pioneers knew about maritime navigation, civil engineering, farming and quarrying, and left some resilient and astounding examples of their work which often represent the earliest, best and largest of their kind yet discovered – such as the stone circles and Skara Brae.

But this was no isolated period of achievement. Eras of iron workers, broch-builders and Viking earls, through to the seafarers, explorers and traders of the 18th and 19th centuries, have all left their mark on the islands, across neighbouring areas and in some cases around the world. Again, in the 20th century, Orkney became a major naval base, oil port and 'model' island authority; further milestones that have been recognised and celebrated.



Maeshowe, Neolithic chambered tomb. photo: Iain Ashman

‘Can we create a sustainable path – Orkney as a digital testbed?’

Fieldnote, Orkney Cloud Forum meeting.

There were recurrent traits within these events: particular skills and commitment were invariably involved, and often combinations of local and outside influences. The outcomes themselves were usually ground-breaking and of wider significance. Other threads running through many of these achievements were the importance of energy and connectivity. In the early eras, energy arose from person power, wood, peat, water, wind and the fertile soils in Orkney; connectivity was achieved solely by boat or ship. Orkney was a productive and accessible base from which to work.

Latterly, these themes appear again. The strategic military and industrial importance of the natural harbour of Scapa Flow, at the heart of the archipelago, is all about energy and connectivity.

Effectively Orkney seems to have been used as a ‘storage cell’, or a base, where strategic resources could be securely held, and from where resources could be transported for use elsewhere.

How did this history of innovation, achievement and strategic importance come about? Is it pure geography, Orkney’s strategic location between the Atlantic and the North Sea, or is there more to it?

Is there an Orkney Way?

From the 1970s to the present, Orkney continued to achieve remarkable things. It further consolidated itself as a research and innovation hub; developed the islands as a major tourism destination; successfully made and marketed specialist food and drink products; became a major base for jewellery design and production, and home to a wide range of acclaimed cultural and artistic endeavours.

It is interesting to explore not just *what* has been achieved, but also *how* and *why*? In the late 1980s and early 1990s the economic and demographic prospects for Orkney looked bleak. The population was under 20,000; predictions suggested that Flotta oil terminal might close as early as 1995 and there were concerns about farming and fishing. These factors led to widespread concerns about the future of the local economy.

Rather than sit back and wait, various things happened. For example, multiple research and development centres were established covering wind turbines, aquaculture, oily water treatment, sustainable island development, archaeology and marine renewables. Alongside these centres a number of local entrepreneurs established ground-breaking businesses in the retail, food and drink, craft, fisheries, maritime, diving, renewables engineering and environment/energy consultancy sectors. ‘Orkney the Brand’ was launched leading to sector-wide development and marketing initiatives, epitomising what can be achieved by collective and aligned working.

This period also saw the birth of the internet, which suddenly put Orkney in the middle rather than the edge of the global data and telecommunications network. The traditional modes of transport for people and goods, such as ferries and air links, as

well as the Scottish mainland road links, were all improved during this time.

Happily the population is now around 22,000; the Flotta Terminal is still in business, the economy has diversified, is much more resilient and is in many senses flourishing.

Energy and connectivity achievements
There are presently two interrelated areas of activity attracting particular attention: the development of more sustainable, decarbonised and decentralised energy systems, and the effective roll-out and exploitation of digital connectivity.

Energy
Hosting the first grid-connected aero-generator in the 1950s was a major (albeit short-lived) achievement. The establishment of the Flotta oil terminal in the early 1970s was the key catalyst, putting Orkney on the strategic energy map. The Burgar Hill wind test site was set up in the early 1980s. This was followed by the Orkney Water Test Centre (OWTC) in the late 1980s, the International Centre for Island Technology (ICIT) in the early 1990s, and then the adoption of commercial wind energy and the creation of the European Marine Energy Centre (EMEC) in the early 2000s. Alongside these individual research and development centres a burgeoning cluster of innovation, service, consultancy, product and project development companies have played an equally important role, in particular providing long-term commitment and investment to keep the energy revolution moving forwards.

Some key Orkney achievements include:

- Operating the Flotta Terminal without a major oil spillage incident for 40 years
- Hosting the world's largest wind turbine (3MW) between 1984 and 1996
- Delivering landmark sector development activities: conferences, resource studies, strategies, action plans
- The first grid-connected offshore wave energy device in 2004
- The first UK grid-connected tidal energy device in 2006
- High levels of local ownership of renewables deployments
- Local renewable generation of 130% of local electrical demand
- Large number of community-owned turbines
- Greatest density of micro wind turbines
- High household uptake of renewable energy solutions
- Designing and operating the largest functioning tidal turbine
- Reducing marine energy installation costs by 80%
- Europe's most extensive hydrogen production and use network
- Significant roll-out of low energy housing
- Ground-breaking initiatives to deliver affordable warmth
- Pioneering research into wildlife behaviour and the impact of renewables deployments
- Developing new, enabling technologies for marine energy activities
- Roll-out of pioneering household energy storage and management systems
- Major community-based investment (around 30%) of the £700 million invested in renewables connected with Orkney
- Export of expertise, technology solutions and services to around 40 countries around the world

‘The Orkney Way... was upgrading the grid ... and getting electrons off the islands. Can we do the same for the Cloud?’

Fieldnote, Orkney Cloud launch meeting.

Hydrogen electrolyser unit, Eday photo: Colin Keldie, courtesy EMEC.

Surf 'n' Turf wind and tide energy to hydrogen project , Eday photo: Colin Keldie, courtesy EMEC.

While early progress was made step-by-step in different areas, there is recognition in Orkney of the need to deliver integrated energy systems. This is stimulating development beyond energy generation into pioneering energy storage solutions, such as hydrogen (see Orkney Surf 'n' Turf project) and household batteries, along with ground-breaking demand control and energy flow management (see Solo Energy's article on p. 48).

This sequence of milestones has been facilitated by many local factors. The relentless wind, pounding sea, raging tides, the surrounding oil and gas deposits and sheltered harbours, are all natural attributes that have played a key role. Orkney's built infrastructure has also been a key enabling factor, particularly the port facilities.

The hundreds of people contributing to energy development have created a cluster of activity, expertise and experience that is truly world class. Other key factors are the characteristic island capacities for inventiveness and supportiveness, along with its welcoming attitude to new recruits and pioneering technological solutions. Alongside this nurturing collective environment there have been 'champions' with vision and commitment, who have worked tirelessly to ensure that things happen.

This combination of natural, social and individual attributes has been at the heart of creating the energy-related opportunities that Orkney has been able to exploit.

However, this is no utopia. There are, of course, local issues around energy that are complex and challenging to resolve. These include planning decisions (such as the acceptable siting of energy infrastructure), establishing progressive customer understanding (enabling households to move from coal to electricity for heating or adopting EVs), and, not least, trying to deal with the affordability of energy services for all, combating fuel poverty.

Wider issues are at times even more complex and challenging. Orkney has always had to chase and sometimes fight for its energy opportunities. For example, the availability and cost of exporting energy to the national UK grid has been too limited or inappropriate – losing the islands hundreds of jobs and hundreds of millions in lost investment and revenues.

A further challenge has arisen from the fact that national energy strategies, standards and regulations are often built on the basis of the 'average' location, town or customer. They have fallen short of addressing the reality of conditions, places and people, none of whom conforms to a so-called 'average', one-size-fits-all, specification.

It is this total experience, good and bad, that makes Orkney a key focus of interest for other communities.

Data and connectivity

In terms of connectivity there is a similar tale to be told, of how Orkney has emerged through adversity to achieve significant milestones.

As soon as it was available, the islands were early and voracious adopters of the internet. A long-term frustration, however, is that Orkney, as with other remote parts of the UK, has often been at the tail end of digital roll out. Orkney is always in that 'special group' of the 1-5% not catered for by central planning or commercial prioritisation of connection capacity. There is irony here in that island communities are apparently the very essence and exemplar of why digital communications are so good for the world, because they are purported to equalise connectivity.

This deficit has now been recognised at some governmental levels, but unfortunately the solutions suggested to date are merely papering the cracks. Given the pace of digital progress, such an approach will simply sentence the islands to ongoing digital poverty. As the rest of the world moves forward to the next new technology, we, along with other islands and peripheral communities, are consigned to catching up with where the other 95-99% have been already.

Islands like Orkney should be recognised and considered as equally valid places in which the future is imagined and made, alongside more urban, mainland locations. Islands also deserve consideration as places where the latest advances in IT technology can be developed, tested and rolled out.

Through a great deal of local commitment, innovation, hard work and some luck along the way, this ideal is starting to be realised. New digital technologies and solutions borne out of, or built from, the Orkney experience, are starting to materialise.

Local IT specialists have found a way of using the old analogue TV frequencies to distribute broadband capability across households and locations not provided for under the national roll-out schemes (such as 'TV Whitespace'). Orkney is also the target for a major study looking at potential options for 5G connectivity (see 'A Day in the Life...' p. 40). A ground-breaking test of a subsea data hub is currently taking place in Orkney and there is also a local digital forum initiative that has supported a number of activities aimed at better defining Orkney's future digital communications and data storage needs. We also have a strategically important fibre connection from the Faroes to the UK which makes landfall in Orkney (although regulatory barriers complicate local use of this link at present).

As well as these infrastructure-focused investigations there is also a growing cluster of IT businesses in Orkney working with specialist software applications, trading online and undertaking complex digital data analysis (see p. 48).

Electricity subsea cable, Rackwick, Hoy photo: Laura Watts

On the back of this digital data and connectivity revolution the attention of insightful major digital/ICT players is being drawn into Orkney's intriguing web of opportunities.

While this digital capacity revolution has not yet quite reached the heights of the energy revolution in Orkney, there seems to be ample evidence that Orkney's unique features could be applied once again to help a pioneering sector make further progress, and help to ensure that this progress works for all.

Defining an 'Orkney Way'

How did all of this focused activity and success happen, and could it have been facilitated by an 'Orkney Way'? If such a way were to be codified and promoted it is interesting to consider how it balances any advantages and disadvantages, and also how it might be honed to achieve an optimal outcome moving forward.

So what might be the values of an 'Orkney Way'? This is something that needs to emerge over time. It needs input from a significant number of people and needs to be considered from a breadth of perspectives. But initial suggestions of some key features might be as follows:

- Forward looking but past aware, taking a long term view
- Resilience, consistency, loyalty, commitment, quiet determination
- Building capacity through collaboration and co-operation
- Progressively inventing and adopting new solutions
- Living with transparency and personal accountability
- Belonging to a community that knows what is going on
- Working hard and playing hard
- Stepping in to resolve issues before things escalate
- Respecting and trying to understand alternative viewpoints
- Creating space for consensus to emerge where possible
- Understanding and working for sustainability
- Experience-based knowledge, making the difficult seem normal
- Contemplating life from an edge, from an island perspective

> 'In Orkney, this is an important step: developing... a sustainable community into the future.'
>
> Fieldnote, Orkney Cloud Forum, public meeting.

Many of these may seem to be universal qualities and traits and there are few, if any, that are peculiar to Orkney. What makes Orkney special is the diversity of the values it embraces, the breadth of adoption within the community and the continuity of effort and application over time. Consequently, could the 'Orkney Way' be described as simply as:

Stepping forward together,
creating the future,
learning from the past.

If an Orkney Way could be defined, how might it be used, and would it be relevant elsewhere?

It is absolutely certain that the world contains many varied and diverse cultures and is a mosaic of particular and possibly unique settings. Across these, however, there are unifying factors that cluster locations together. As we have seen, the range of Orkney attributes is remarkably diverse and rich, especially for an island community. Consequently, although the whole Orkney system may not be packaged up and exported elsewhere, there are individual and combinations of features that could be used in other places.

Orkney – the 'living laboratory'

Whether or not there is a distinctive or describable 'Way', there are clearly strong foundations of innovation and achievement,

‘ Through renewables, Orkney has generated 130% of its electricity needs, and... has contributed substantially to the decarbonisation, decentralisation and dispersal of energy systems.’

Gareth Davies, Aquatera.

Burgar Hill turbines photo: Aquatera

along with many other complementary attributes, that make Orkney an ideal 'living laboratory'. Importantly, this is not a recent construct associated with a building, campus, street or even a community. The foundations are set in the stone, soil, water, wildlife and weather that characterise the islands, and they have been built on and exploited for over 5,000 years by successive generations that have thought, created, innovated and achieved.

Another key to Orkney's success, especially regarding energy and data connectivity, is the size of the community. It is big and diverse enough to provide opportunities for a number of system integration tools and solutions to be exploited, but not too large to make the costs of testing and demonstrating such solutions prohibitive.

Orkney's archipelagic structure is another special feature that enhances the diversity of investigation and demonstration opportunities and their analytical integrity. Each island within Orkney is its own clearly bounded community and environment – or microcosm. Each can be explored, supported, stimulated, measured and analysed on its own, in contrast or in partnership with others, or collectively with all of the islands that make up the Orkney archipelago.

Recently, energy has been a major focus for demonstrating innovation within Orkney, helping to reinforce its global profile as a living energy laboratory. Through renewables, it has generated 130% of its electricity needs, and developed and proved numerous novel energy generation and other technologies. It has motivated and mobilised the wider communities to embrace change in their relationship with energy. Overall, it has contributed substantially to the decarbonisation, decentralisation and dispersal of energy systems.

There may well be similar opportunities for Orkney to lead the way as a 'living laboratory' for digital data connectivity, storage and analysis. Emboldened by the success with energy, there is a growing focus on, and recognition of, the challenges and opportunities presented by dispersed data systems.

Such moves could also lead to pioneering breakthroughs in areas where data and energy might combine, such as automation of transport, transformational energy efficiency, next generation smart metering technology and distributed energy generation. Other sectors that could benefit directly from this include food and drink production, tourism, culture, health, social care, transport and logistics.

In delivering such an ambitious remit, all of the attributes that help Orkney to tick and make it special will need to be mobilised. Any strategy embracing innovation is not only a major plank of the economy, it is also a basis for how the wider community functions and relates to its environment. Overall success will be achieved if the issues that always come with change are effectively and collectively recognised and managed.

This is where an 'Orkney Way' may help. It may be no guarantee of success but something has consistently and repeatedly helped Orkney achieve what many others have only been able to dream of. Formally or informally, defined or defuse, real or imaginary, the way in which things happen in Orkney seems to be different, distinctive and special.

Given the challenges faced in the world, not least regarding energy and data connectivity, perhaps this way of doing things could be another gift emerging from Orkney – the 'living laboratory'.

Gareth Davies has worked as an environmental consultant for over 20 years. Since founding Aquatera Ltd in 2000, Dr Davies has been deeply involved in the development of the marine renewables industry in Scotland.
www.aquatera.co.uk

Billia Croo and Hoy Sound, Orkney. August 2009. Installation of the Oyster wave energy device at the EMEC test site photo: Alistair Peebles

collaborate

Sharing our stories

The powerful potential of community-led research

BECKY FORD

My PhD research project looks at the impact of the Marine Renewable Energy (MRE) sector in Orkney – but rather than collecting statistics I'm more interested in stories.

I grew up in the harbour town of Stromness, which is now the home of the European Marine Energy Centre (EMEC), and the focus of international attention due to the cutting edge marine technologies being tested here. When technology developers plug their devices into EMEC's test facilities they are connecting to more than Orkney's electricity grid; they become connected, through EMEC, to the Orkney community.

In thinking about the role of stories in this connection I have come to realise that community, just like research, and technology development, is a process. Community is more than just a way of describing an anonymous group of people living in a place; it describes a way of being, the on-going interaction and engagement in the relationship between those people and that place. Community makes things happen, it is a social experiment that is never finished, and can never be replicated. Stories work to weave people into this process; stories make individual events part of collective experience and shared knowledge.

The Orkney community holds a vast store of stories, a wealth of knowledge, and in this it is not unique; but what is unique about Orkney is the interaction between the processes of research and community.

In looking at the development of the Marine Renewable Energy sector in Orkney I have seen the way local knowledge has become part of the process of developing new technologies. Not just knowledge of wave and tide, or technical expertise, but knowledge of how to collaborate, how to work together to solve problems and set aside individual conflicts to focus on shared goals.

Those involved in the MRE sector in Orkney are well aware of the importance of community; at nearly every public presentation someone will describe Orkney as a 'living laboratory'. While this description captures the blurring of boundaries between the processes of research and community, as someone sensitive to the layered meanings in which language is entangled, the 'laboratory' might suggest a relationship in which power lies with those who can claim professional scientific authority. Although repeated often, this doesn't fit well with a dominant cultural narrative in Orkney that emphasises the egalitarianism of the community. To be 'bigsy', the Orcadian dialect word for being conceited, is to think yourself better than your fellow islanders, and this undermines the sense of shared community identity. The desire to emphasise community cohesion over individual authority works to strengthen the sense of shared connection to place, and pride in the community as an expression of that place. As one of my informants put it, 'you can be as bigsy as you like about Orkney'.

> ‘It is the word, blossoming as legend, poem, story, secret, that holds a community together and gives a meaning to its life.’
>
> George Mackay Brown, ‘An Orkney Tapestry’, 1969.

So how can we re-imagine Orkney's ‘living laboratory’? Navigating the process of community is complex: it is situated, interactional and dialogical – individual communication and collective knowledge flow both ways. As someone carrying out research in Orkney the laboratory metaphor with its sense of detached observation, whilst useful, fails to capture the participatory nature of the relationship between the research and community, those doing the research become part of the community and community knowledge becomes part of the research. For researchers coming from outside Orkney, who are part of an academic community with a cultural narrative based on objective observation and a competitive authority structure which values individual achievement, knowledge is a currency to be collected, transferred or exchanged, rather than a process of relationship building.

As Orkney attracts more researchers to the islands, across a range of interests from energy to archaeology, how can we help them to join in the process of community? How can we share knowledge, build relationships and make sure that research is a participatory process that benefits both researchers and the communities that welcome them? How can we translate the Orkney stories for those seeking to understand what makes Orkney such a centre for innovation? These are all questions that I have been wrestling with as I think about my own role as both researcher and community member.

Inspired by examples such as the Civic Laboratory for Environmental Action Research (CLEAR) in Newfoundland, who are committed to working with, and as part of, the community at every stage of the research process, from identifying research topics to community peer review of research findings, I have started to consider how we could develop community-led research in Orkney. The Orkney Cloud Project is looking at the potential for Orkney's thick social networks to problem solve the technical challenges of connectivity.

The infrastructure challenges faced by Orkney's renewable energy generators, and by islanders frustrated by patchy mobile coverage and inadequate Internet connections, reflect the way centralised power structures, whether political, technical, economic, or academic, fail to understand the importance of local context.

As the Orkney Cloud works to share knowledge and find local solutions to these technical challenges, I would like to suggest it could also help start a bigger conversation about community-led research. One of the core principles of Permaculture is ‘the problem is the solution’. If the problem is research failing to benefit the Orkney community and missing out on local knowledge, due to a lack of engagement with local people, and by researchers who do not understand the local context, then perhaps the solution is to initiate community-led engagement with researchers.

In conversations with friends and colleagues I have been trying to re-imagine Orkney's ‘living laboratory’ as a research community, led by local concerns but open to anyone interested in learning how Orkney does collaboration, engaged in knowledge sharing and careful problem solving, sensitive to the needs of both people and place. Orkney stories weave together the imaginative and the real and make things happen. As George Mackay Brown wrote in ‘An Orkney Tapestry’: ‘it is the word, blossoming as legend, poem, story, secret, that holds a community together and gives a meaning to its life’. I imagine Orkney leading the way in community-led research, helping academic researchers learn how to engage in the powerful process of community. It’s time to start sharing those stories and working to make them a reality.

Becky Ford is a PhD student at the University of the Highlands and Islands, based at the Institute for Northern Studies in Kirkwall. Her PhD title is ‘Words and Waves: a dialogical approach to discourse, community, and marine renewable energy in Orkney’.

imagine

Eday's Data Island – through the looking glass...

ANDREW STENNETT

Eday is an island at the heart of Orkney with around 130 people, a community-owned wind turbine, a tide energy test site, a hydrogen fuel electrolyser; in short a micro-grid playground. Andrew Stennett from Eday takes us 'through the looking glass' to imagine a sustainable data future for the island...

'Fine words butter no parsnips', but fine data users know their data onions. It's not until you dust off your microscope and look really closely that you get to 'know your onions' in your data network, because you can see every garlicky fibre in earth-shattering detail. In a similar way, car faults remain a mystery (to me, at least) until you can see what's really going on under the bonnet.

To store that detail into the memory banks (for recall at a later date) would require a digital high-res black-and-white photo. More could be revealed from an infrared image and more still from a colour photo, but each level would require ever increasing amounts of data (both for memory and processing).

The benefit of improved perception has a data-cost. More data processing, more data storage, more power.

I've recently seen a low-res portable ultrasound machine in action that's wheeled around on a cake trolley. Whilst hooked up to the patient, the consultant assured me he had a handle on what he was seeing on the screen, though to me it looked like the white random flecks of a very small black-and-white TV with no signal.

I believed him when he said he understood what he was seeing, but I wonder how much more useful it would be if it were jettisoned off the hospital ward and replaced by a device with better contrast, colour, high-res, virtual reality, that could record moving images in real time for recall later. Imagine, for example, how useful it would be to see a super clear image of your developing child, or a precise diagnosis and location of a medical condition needing urgent attention, or a clot on the brain, or a hot spot on a lymph node, or portable mapping to alert for skin cancer, and all in real time, in high-res and right at your fingertips. Yes, there'd be a cost, both for the equipment and data processing/storage, but wouldn't it be worth it?

Data in renewable technology, is currently, at least in our experience very pixelated; good in parts, blurred in others.

Cue stage left to a nimble news presenter dancing in front of the oversized smart TV, excitedly gesticulating with his clicky pointer thing. 'Let's take a ten minute sample of a 1MW wind turbine data: it's got an average wind speed of 7 metres per second and average output of 100 kilowatts/hour (KW/h), but what actually happened in those 600 seconds? Was it steady away across the whole period? Or was there a rush of energy at the front and the rest was a trickle? Or were there any number of other permutations?' Mr Newsreader skips off stage right. For all this excitement, all that the viewer can sense back on their pizza-ingrained TV sofas, is a tale of averages, told in a pretty average way.

Micro wind turbines powering Eday homes photo: Aaron Watson

The problem is our current view can't pick out any of this fine detail because it's all too 'broad brush'. The chunks are just too chunky: the pixelations hide the meaning. Data remains raw, and the bridge to useful information remains impassable.

Now let's pick that ol' Orkney chestnut - curtailment. To explain, if all the supplies from Orkney were added up and all the demands from Orkney were added up, then if supply outstripped demand some wind turbines would be expected to 'stand down'. They would experience what's called curtailment. If they didn't, excess energy would place undue wear and tear on the cables through heat.

Fortunately, however, Orkney folk are well-known for their resourcefulness.

Take Eday, for example; an eight mile-long bejewelled isle in Orkney's renewable crown, just one hour's ferry ride from Kirkwall. They have a community-owned turbine which has been asked to 'stand down' rather more frequently than expected.

Eday has found a way to 'rejoin the parade', by reclaiming some of its curtailed power by converting it into hydrogen, thanks to EMEC's Eday-based electrolyser and the Surf 'n' Turf project.
www.surfnturf.org.uk/
It is then stored in a portable gas battery which can be transported to where it is needed most. It is then converted back to electricity at will. If it can't be exported now, it can be saved for later.

Eday knows its average curtailment in blocks of ten minutes, daily or monthly. It would be really cool if Eday could see historically what was happening under the data microscope, as a blow-by-blow account, down to the split second.

But what about predicting curtailment behaviours in the future? One bright spark might raise an extended index figure to the sky and say 'all very well, but I really don't know how the wind will blow on the morrow?'

If you stop to think about it, though, weather forecasting has become much more reliable over the past few decades. Huge amounts of global data collection, collaboration and processing have created what can only be described as a data-miracle with dependable, robust information providing a trusted lifeline to both businesses and communities alike. ('How many ice creams shall I make for my business?'; 'let's increase production of umbrellas'; 'let's plan to evacuate folk from grid reference xyz'.)

If weather can be forecasted so reliably and there is a partial correlation between curtailment and weather then surely it could be possible to make the same leap forward with short term local energy forecasting?

If the data could be collected and sent to a central place of processing, say, for example, Eday's Data Island, one could, as a starting point, bring all the strands together by historically mapping the following data to the nearest second; *Average wind speed? Maximum wind speed? Wind direction? Precipation? Temperature?*

Against other Eday wind turbine criteria: *Power generated? Power lost? Curtailment duration? Curtailment cycle, all at once, partial or stepped? How does seasonality affect curtailment?*

Against grid/microgrid criteria: *How much room on the grid/micro-grid at any one time? How does seasonality raise/lower that bar?*

And then correlate all that against all other components in the grid system such as other firm and non-firm suppliers: *Power generated? Power lost? Curtailment duration? Curtailment cycle, all at once, partial or stepped?*

Demand criteria: *Where, when and how much of each type of power are businesses and residents consuming? Where, when and what are the drivers to demand (e.g. heating, industrial processes, adverts during the football match)?*

Once all that historic information has been collated and logged, artificial intelligence could be used to inform a picture of what the near future might be like when any given environmental condition is met. (For example, one rule might look like this: if wind is greater than or equal to 11 m/s and curtailment is less than 10%, and it's night time in December, Moiraxa* tells Eday not to divert to the microgrid when curtailed. *[*Orkney's version of Alexa?]*

Once a data encyclopaedia of rules has been compiled this can be juxtaposed on live data to extrapolate forecasts of the near future, in real time.

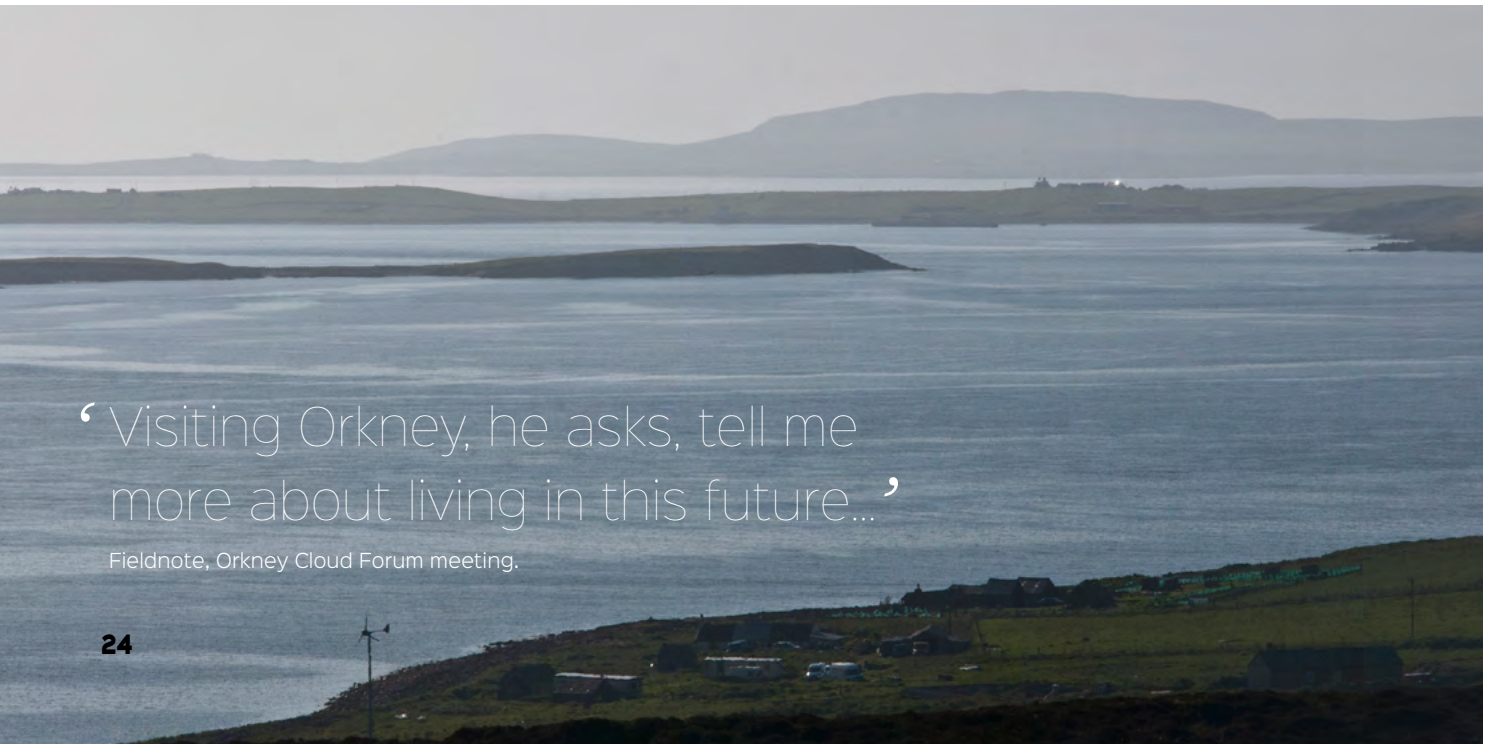
This would result in a beautifully-crafted energy dovetail: no gaps, precise, and bespoke. A perfect synchronised fit symbiotically matching supply with demand offering potentially massive reductions in wasted energy. This could be used by all stakeholders to tactically manage their assets in real time.

Look deep down into the blurry data abyss and see if you can pick out what lies beneath: patterns of correlation, threads of understanding, trends, opportunities, threats.

Eday's Data Island through the looking glass represents one possible way that a data centre could be used to predict short term energy futures. Oh, and one other win - the energy to power the data centre will free up yet more curtailed energy, making more money for the community.

Disclaimer:
Please note this is, for the most part, an imagined scenario, intended to inform and entertain, and makes no claims as to its technical feasibility, nor factual accuracy ... Enjoy.

Andrew Stennett is the managing director of Eday Renewable Energy Ltd.



‘ Visiting Orkney, he asks, tell me more about living in this future... ’

Fieldnote, Orkney Cloud Forum meeting.

View from Eday towards Westray photo: Aaron Watson

What is grid curtailment?

Quick background to the Orkney Smart Grid

Orkney's Active Network Management (ANM) **www.ssen.co.uk/ANMGeneration/** *is the grid operator's tool to monitor excess energy generation and balance electricity supplied against electricity demanded. It does this by turning off those wind turbines it controls, under what are called 'non-firm grid agreements'. Which of the non-firm turbines are turned off first is determined by a turbine's position in the 'stacking order'. This works on a last in-first off basis: 'in' meaning date of signed grid agreement, 'off' meaning the point at which a turbine experiences curtailment.*

It should be pointed out that ANM is a very clever grid-balancing mechanism and following its Orkney pilot, the system has been rolled out across the country. It's beneficial because it allows more 'turbines to the table' including many community-owned turbines. This works because when the grid cables get too hot due to excess supply, ANM can take direct, remedial action by turning off turbines, temporarily. Without it there would need to be a lot more slack built in due to lack of control-ability. More slack and more required wriggle room, would mean fewer 'turbines could be invited to the table'.

Curtailment is rather like an iceberg under the sea; it's not visible, but, even though concealed, can form a large part of a turbine's energy story.

Curtailment can be calculated using the turbine manufacturer's power curve. If we know what the wind speed is (from the turbine's anemometry station) we can extrapolate what the power should be – from the power curve. If we deduct what the power should be, from the actual power we generate, the difference is the power lost – or curtailment.

The more a wind turbine is curtailed:

- *the more catastrophic a 'do-nothing' strategy would be for that turbine*
- *the greater the opportunity for reclamation of lost power by diverting it to a useful load such as production of hydrogen, powering a data centre, for instance*

And that, in a nutshell, is curtailment on the Orkney Smart Grid.

The Stone of Setter, Eday photo: Aaron Watson

Hoy photo: Neil Ford

fable

Data Howe: science fiction short story

LAURA WATTS

Orkney has many folktales about powerful beings that lure islanders into their prehistoric chambered tombs, like Maeshowe, which are found all around the islands...

Sea haar held the island with a heavy salt hand. Around me, the air formed a smooth grey sphere, floating along with my feet. I walked alone through Hogmanay – New Year's Eve to some – with two more houses to attempt down the long stretch of pitted tarmac; neighbours where I was expected to put in an appearance with a smile, be company, be what was needed, play the expected role.

My smile had been worn away long ago. Maybe it had never been a smile, just an open expression that had become threadbare from being pressed upon too often. I touched my face with chill fingers, wondered what emotion lay there. It felt blank, a smooth, cool surface that some artificial intelligence could project feelings on to, be programmed to evoke emotion in, but remain uncomprehending. My cold cheeks stretched over imagined metal bones and silent servos.

My stride seemed to have no effect on the distance travelled. I walked onwards without moving, the haar unchanging, the tarmac glistening in repeating patterns beneath my flashlight. Ten more minutes, I guessed.

Water gathered and dripped from my ear, a faint tickle which I rubbed away, irritated. I tried to create an excuse to bail, but knew that not seeing Joe at some point tonight would be unforgivable, another black mark that would be held against me forever. And, well, he deserved a good stream of visitors, and it would only be half an hour before someone else would turn up to rescue me and take over. Joe wasn't so bad, on the 'mostly harmless' scale, and he might not be around next year, in truth. I would just have to hope he'd not mixed spinach and sorrel into his lethal brew, like last year's attempt at 'herbal' gin. All I needed to do was drop by and listen to his annual ghost stories. No one knew if he prepared them in advance or not, but they were always fresh, and grew more inappropriate and outrageous each year. I had tried to expunge last year's account of seeing an unnamed friend one night on the beach with a seal and a length of copper cable.

I walked to the left a little, and found the cracked transition from tarmac to verge. Liking the sense of getting somewhere, I stomped on to the sodden, uneven grass, and strode through the soaking blades, following the line of the road. In one muddy bare patch, I saw a boot tread. The cat paw pattern could only be from Hannah's wellies, which meant she was ahead. With luck, she would already be at Joe's, where we could do a double-act when I arrived.

The grey wall ahead brightened. Car. I stepped hard left, deeper into the verge, torch out for the fence that would be between me and the field. There was nothing there, just grass, moss, mud giving way to peat. Odd, but it wasn't like I could get lost. There was only the one road at this end of the island.

The grey wall condensed into two moons, waxing in the cloud. They glowed white. The car was going too fast. I stepped back further from the road, slipping into the haar, ears twitching for the faint hum of the electric engine and the crackle

of tyres on tarmac. Likely it was Mork and Mindy, heading home (their island names somewhat stuck). In which case, who knew which assortment of breaks and gears might be working in their island car tonight, or how many brain cells might be sober between them?

Gravel crunched, and an electric hum grew. With my flashlight bouncing in the air, I felt like a small flame with a car-sized, drunken moth heading at me. I shut off the light. A second later, a small white car rolled past and disappeared into the haar, leaving only a red warning afterglow. Mork and Mindy heading home. No doubt merry, perhaps bickering about the evening's most incredible island story, passed off as true.

The haar hung on my shoulders. I was too sodden, too tired of pushing on, alone. I wanted to be home, warm.

There ought to be a shortcut along the beach, off the road, away from everyone – even though there was no 'away' on an island with a hundred people and a chambered tomb with their prehistoric dead all watching. I shone my flashlight towards the field, in the direction of the sea, listening for waves. Nothing, even though the wind was right down. Well, the sea was out there. It would be hard to miss.

I walked in roughly the right direction. Where was the fence? Nella had an electric fence here. I had been away for a few weeks, though. Maybe she had taken it down. I swung the light ahead, back and forth. More field. More stones coming out of the peat, loosened from the flagstone earth. I listened for the kye (cows) calling from their winter byres. Silence. Like a pressure.

I strode on, belligerent against the salt-wet field that soaked through my boots and socks, seemed to soak through my toes to reach cold metal bones beneath. I might as well be walking barefoot. Still no fence. No nothing. Maybe Nella had rolled it back to drive the tractor in? I must be close to the sea. I stopped to listen, thought I heard it hissing and booming over sand and cobbled beach. I kept going, dogged, and ran through the order of events: get to the beach, turn left, walk along the stones, through the stream, and clamber up to Joe's croft house; then drink some gin punch (minus spinach), listen to a story or two, wait for reinforcements, walk home, and sleep.

The circle of torchlight reflected from a sudden wall ahead. It was harl protected with pebble dash and lime render, like many on the island. I sighed with the sinking realisation that I was going to be all masked up and smiling sooner than I liked. The muscles in my face stretched in readiness.

Whose house was this? I cursed my self-absorption. I was an excellent navigator, and never got lost. (Not much of a claim on an island with fifty houses and two roads, I admit.) I swung the light over the pebble dash wall, the warm grey enticing under the cold beam. I walked along its empty expanse, searching, but there was no window or corner. Not a house, then. No island house was this big. Embarrassed, thankful to be without witnesses, I realised I had absolutely no idea where I was.

The wall ended in a corner at last. I shone my beam, expecting the reflected glare of parked cars and a few bodies puking quietly into the long

grass. My smile formed, at the ready. Nothing. Just a corner and more field. More harled wall. Only, now, the sea radiated white noise into the air around me. I must be on the coast.

I kept walking, ranging my flashlight ahead where the grey mist met pebbled wall. The bright circle broke, sank inwards: a dark entranceway. I searched for the edge, outlined a large wooden entrance, slatted as though it rolled upwards. No handle. I walked on, exasperated, but then found a heavy wooden door, person-sized. No handle on it either. Marvellous: must be a push-to-exit fire door. My teeth clenched in an irritated growl. What was this building? It was something industrial, but the substation and switching house were both at the other end of the island. Had I got turned about in some strange way? I knew I was off the island more than most, but usually the ferry talk kept me up-to-date. No one had said anything about a new building yesterday. I'd not seen any builders staying at the hostel. Also, December was not exactly prime building month in Orkney. The sun would be down before you'd laid two bricks. Maybe Joe would know. More likely, the rescue party who arrived to take over from me would fill me in.

I felt guilty. I should not be away from the island so much. I dreaded the conversation that must come later, the way it would show up my absence, my unreliability; letting folk down. I could almost hear the island muttering darkly from the mist. I kicked the wooden fire door with irritation. There was a scrambling sound on the other side. My spine clenched my legs and threw me three steps back, just as the heavy fire door slammed open. A face appeared, grey utilitarian corridor stretching behind. She was pale-skinned under black hair, braided into a high punk pompadour. I had never seen her before. She stared at me for a moment, then grinned.

'Hejsan! Get in, girl!' She definitely began with that Swedish greeting. At least, I think she did. It was hard to place her accent. I hesitated. But the woman was insistent, 'I'm bored to m'bits. No way to spend Hogmanay!' She gestured me in, impatient.

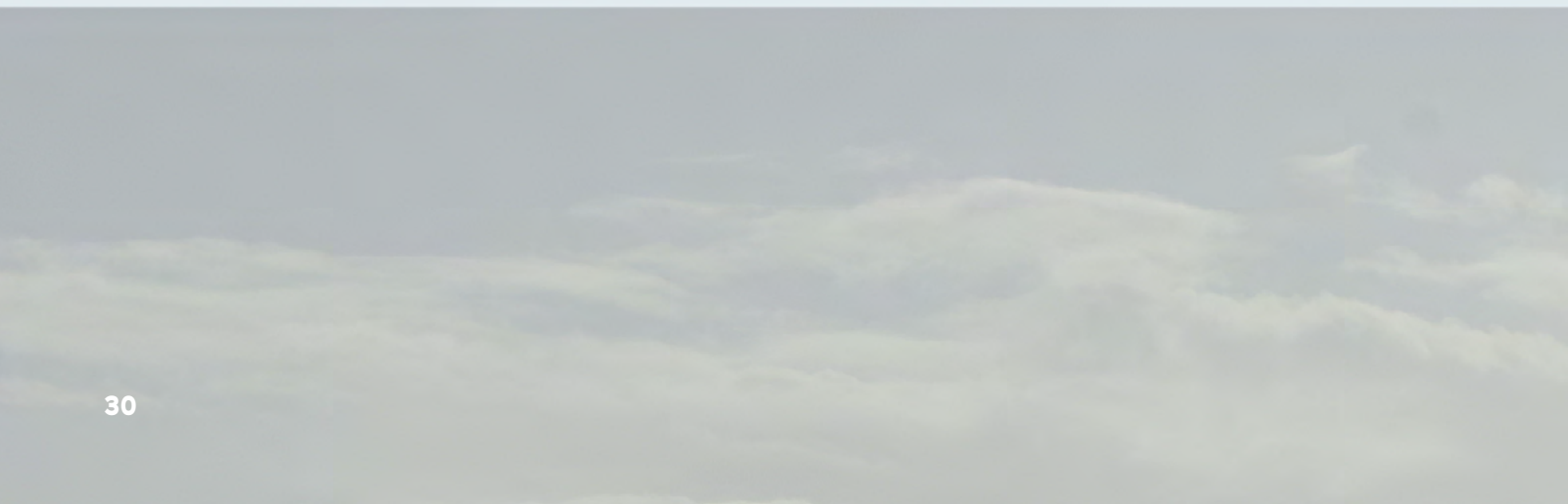
There are moments when life makes no sense, but you just go with it, like falling and break-rolling to find yourself on your feet again, facing in a new, unexpected direction. 'Hi,' I said, rolling with it, finding myself still on my feet, but with even less sense of where I was than before.

I stepped into the smooth grey passage, white strip lights down the ceiling still blinking on. My imagination informed me that it was just the sort of corridor down which aliens or vampires masquerading as technicians led their victims. The door at the far end did nothing to break the uneasy fantasy: it was heavy grey metal with a wheel on, like an airlock hatch.

The woman (younger than me, although she was quite age indeterminate, somewhere over twenty and under forty) slammed the fire exit closed behind us (it sounded heavy). She strode past me without a glance, reached the hatch, spun the wheel, leaned with her shoulder, and pushed open the metal seal with a low clunk. (Not a quick exit point, that was for sure.)

Beyond was an expanse of metal pipes, riveted, bright colours bending around each other: red, orange, yellow, blue; a tangled rainbow. I stepped into the vast room and looked around. Above my head was a morass of glistening black cable, seeming to slither under cold spotlights from a metal panelled ceiling. I took it in, then looked at her, feeling a strike of cold.

What had been going on for the past few months? Was this some new tide energy substation? Was it connected to the hydrogen



electrolyser? Or something related to the new electric airport? Which island bastard had decided to keep this a secret from me? Was this some punishment for my frequent absence? (We'll just build this great big thing, and not tell her, because she's never here.) I was furious, rounding on the woman, wanting answers. But she flung her head sideways, long braid flying, and raised her eyebrows at me, a direct challenge. I took in her appearance with more care. She was solid, wearing a blue boiler suit, a farmer's uniform, with grey boots. Was she someone's daughter, back from south, studying? She had a distinctive round face, like no one I knew on the island. I was about to ask her, when her eyes defocused for a moment.

Then she focused on me again. 'Sorry, the water didn't sound right for a moment. I wondered if it had got bunged up again. Might have had to go for a swim.' She smiled wide. 'Kara.' The accent was almost Orcadian. Almost, but not.

'When did you move here?' I asked, beginning my island inquisition.

'I've been here forever!' She laughed, grabbing my waterproof sleeve. 'Come on, have a drink with me. Save me from drinking with the fish!'

Kara pulled me towards a pale door in the grey wall, beside the hatch, which she spun closed (sealing us in, I noted). The door was blank (no handles again) but Kara's fingers danced over a keypad on the frame, and the door swung open towards us, silent.

She stepped in to a small cluttered room, grey plastic boots squeaking on the grey painted floor. I followed her, because it was Hogmanay, and she was an islander. And this, although a bit odd, was possibly not the oddest thing to happen to me on Hogmanay. Walking the length of the island, or as far as you could, from house to house, sharing a drink and stories with neighbours and folk, was just what you had to do. And, thanks to the extra drams, and the peedie eccentricities that we islanders hoarded, things sometimes got a little weird, usually about two in the morning, which it probably was, now.

The room held a battered white melamine table, surrounded by uncomfortable chairs of mixed origin. In striking contrast, down one side of the wall by the door, was a long wooden desk, carved with spirals over its surface. If it wasn't oak, it was an impressive laminate. On the desk were two curved monitors with a wireless touchpad below them. No keyboard. Very swish. But then I saw that the monitors had noticeable chips in their frames, and the touchpad looked like it had been doused in tea at some point. Just as well I wasn't managing this facility, or whatever it was, as that kind of damage to what must be serious and brand new kit would have had me coming down like a hammer (with a blunt end, you always have to stay polite). We could not afford that kind of damage on the island. It cost too much to get repair engineers out, even when they agreed to come at all. But that was all irrelevant. Another time, another place.

The room was warm, humming, and I began to relax, stretched my shoulders. There were children's crayon drawings on the opposite wall, stuck in between shelves filled with scratched metal toolboxes and plastic crates.

Kara waved at the white table, gestured me to sit. I chose the least uncomfortable looking chair, with the least bent legs, and sat in genuine pleasure, pulling off my jacket. She reached down to a cardboard box on the floor, and pulled out two not-entirely-clean glass tumblers, along with a bottle of 18-year Highland Park whisky, which instantly made me grin and give marginally less of a care about who

she was, and what this was. If she was the kind of person that could produce a bottle of 18-year Highland Park out of a cardboard box, then she and I were going to get on famously. (It's a pretty high bribery bar, that's stuff's not cheap.)

She dropped into one of the chairs, wobbled for a moment, and with a practiced kick shoved a paper wedge under the missing foot. The chairs must have been rejects from the Heritage Centre. I nodded my acknowledgement of her skill. Kara leaned back, tripped her feet up on another chair, and poured two drams. We raised our glasses, two islanders toasting the new year.

'Skål!' we said together.

I blinked, surprised at her. That was my line. No matter. I stretched my spine, leaned back, dry and out of the haar. I had no idea where I was, or who I was with. But my companion was an islander with whom I did not have to navigate twenty years of history and family feuds. All I had to do was let the whisky coat my bones with honey.

The imagined servos under my face stopped whirring, and I felt a dreamy blankness roll over me like a calm sea. My eyes rested on Kara, her head back, enjoying her dram. And on my calm sea face, I felt the dimpling of stars, twinkling.

'I don't know what this is.' I waved at the building. 'But it's great – I can feel it's great.' And I could. The building felt right, like it belonged here. I felt right, like I belonged here.

Kara nodded. 'It took a bit to get the data centre here. Someone, I won't say who, of course, practically sailed off in protest. I'll not get any tea from that hoose.' (House? Haus? Hoose? I could not get her accent.) 'But if we can do energy, then we can do data, right? It's all just cables and poles. All just the same stuff.'

I toasted her. 'Absolutely!' Data was just organised energy moving around as information. Or maybe she meant that one required antennas on poles, and the other wind turbines on poles.

Our glasses were empty, and Kara gave us another pour. I smelled amber resin, peat and vanilla gorse, sucked them down. 'We've got the wind, the tides. We've made the hydrogen.' She raised her glass. I joined her in agreement. 'But we don't want all our eggs in the energy basket, right?'

I nodded, lifted my glass again. 'You moved fast,' I noted, wondering if I could wangle the story out of her.

'Don't we always?' Kara smirked as she downed the rest of her dram. She poured again, then held up her finger. 'Hold on.' She got up and flicked on the monitor, flicked her hand over a screen (very nice), and music came out of some speaker. It was some folk fusion, trance, at a guess, with fiddles and folk whistles over a beat.

I toasted her choice. 'Tell me about it,' I invited her, beginning a more serious attempt to get the story of the building.

'Mark and Dido had the idea, as you'd expect.' She grinned at the islander joke. Except, I had no idea who Mark and Dido were. So I shelved their names under nearby Sanday or Stronsay, sure I could find out later which island they were from, and motioned her on.

'We had the Feed-in Tariff from the turbine, for a while, until it went belly up.' She rolled her eyes. 'So, Dido found out about some scheme for a Feed-in Tariff for data.' I blew out. That was news. Things happened fast while I was away. 'We're farmers, right?' Kara said, picking at her blue boiler suit. 'So, data farm!' She did jazz-hands at our surroundings. 'The kids love the fact that all their postings go through here, and mash up with feeds from Iceland, Faroes, Newfoundland, wherever.'

She pointed at the wall and I realised the kids' drawings, in between the toolboxes and crates, were of a squat grey building in a green field,

with our wind turbine and tide turbines in the sea besides, and faces peering out from inside the building. Who knew? I didn't.

'Who funded it?' I asked. Who are we indebted to, I wondered, so I don't put my foot in it.

'Oh, the usual. The council, research funding, some universities. We're part of the Green Data Network. You know about that, right?'*

I shook my head, sipped more whisky, happy to listen and learn. 'No. Tell me.' I flashed an honest smile.

Kara chuckled. 'Not many people understand it. I like your honesty. Reminds me of home.'

I pounced on the morsel of information: she was not from around here. That explained a few things. But she was here, now, and I felt thankful for stumbling over her door. With a sudden knowing, I realised this would be the first of many evenings, the first of many idle chats over a chipped melamine table with someone who made my face calm and then twinkle in its depths.

Klara nudged me. 'So, the Green Data Network is like the energy market: trading data on the basis of renewable energy supply.' This made sense, but to be honest I was not really following her. I was just drifting. How long had I been here, drinking whisky under this great mound of a building by the sea? Was the sun coming up?

Joe. I hadn't seen Joe. My neighbour. My storytelling neighbour, who lived for tonight and its visitors, who struggled to get out of the house, and who I should see more often. Joe, who I wanted to see before the sun came up on the morning. It wouldn't be Hogmanay without Joe's stories.

'Listen, I have to go,' I said. 'You know...' I trailed off, not sure how to explain.

'Are you sure?' She waved the Highland Park bottle at me.

'I'm sure.' I pulled on my jacket, easing it over my wrists, expecting a sodden chill to follow. But it was warm and dry. I zipped in the whisky heat, and glanced through the open door, into the cooling room.

Klara grabbed my arm, turned me back to her. For a moment we stared. I do not know what she saw on my face. I cannot tell you what I saw in her, for I swallowed it whole, leaving only a trace of brine dripping from my eyelid. Then all traces were gone, and she was ahead, spinning open the hatch, leading me back down the corridor, out to the fire door. Before I could blink, I was thrown into the haar with the sound of the sea, hissing and booming on the beach. Warm to my ears, still twinkling, I hurried on to Joe's.

And, do I need to tell you the next morning? Well, if I must.

I woke to clear sky with Jupiter fading, unplugged the car, and drove back down the road. But there was no industrial building, no data centre, no Klara with her braided punk hair; nothing but the surf and the wind coming in hard from the north. For a moment I was hit by a sense of loss, as when an islander passes. But then I rolled with it, got back in the car, and drove on to see how Joe was doing; on the seat beside me some turkey pieces, and a Highland Park bottle, rattling in a box.

* Inspired by the GreenClouds project in the Netherlands.
doi.org/10.1109/DASC.2011.131

Laura Watts is a writer, poet, ethnographer of futures, and Interdisciplinary Senior Lecturer at University of Edinburgh. Her latest book combines research and storytelling, and is based on ten years of fieldwork on futures in the islands. 'Energy at the End of the World: an Orkney Islands Saga' is published by MIT Press. **www.sand14.com**

Moon Rock

Why on earth?

The first 'Moon Rock' was a temporary site specific work I made as part of a live arts project held on the island of Mohni in Estonia. There was a decommissioned lighthouse on the island and I wanted to do something in response, something that could be seen from the mainland. There were huge glacial erratic boulders on the shore – I decided to cover one in silver. A few energetic days later this rock became a reflector, a beacon, a brief alternative for the few boats travelling to this once busy island.

However this was by no stretch any kind of practical navigational substitute. Instead, the afterimage of the silver boulder glowing through the mist lasted in my memory, my imagination, becoming more mythological and somehow magical with time.

Several years later I was in Rackwick on the island of Hoy, in the bay with its 'mirror of whitening light'[1]. I selected a rippling boulder and waited for the tide to recede. Between the ebb and flow I covered the surface with a new skin, burnishing and polishing, animating the dark hard rock to sparkling shimmering fluid - a mirrored section of sea.

The latest 'Moon Rock' shimmers from the Stromness West Shore, in view of the (still working) lighthouse of Hoy Low and the Hoy hills. Thinking again about communication, connection through reflection and conversations about time[2], this lasts only as an afterimage from the walk around the shore, perhaps a figment of your imagination, a momentary glimpse of the ancient waves of Lake Orcadie...

'the Martians are Coming!'[3]

Moon Rock: Rackwick
2015
cover image

Moon Rock: West Shore
2017
right

Materials:
Aluminium sheet and rock

photo: Anne Bevan (p. 34)

1 Composition by Peter Maxwell Davies

2 This work was made as part of an interdisciplinary AHRC Science in Culture project - Orkney Beside the Ocean of Time – see project website **www.oceanoftime.uk**

3 'The Martians are Coming' (Orkney Islands, Scotland: Alvis/Stromness Academy, 2010) - a children's story by George Mackay Brown

Anne Bevan is a visual artist, researcher and Curriculum Leader for Art & Design at Orkney College University of the Highlands and Islands. Her artwork combines sculpture with photography, video, sound and text, and she often works collaboratively with people from other disciplines, focusing on themes concerning place and environmental change.

network

Orkney Cloud Data Centre

PHILIPPE BONNET

Data centres are the backbone of the digital economy. Today, all organisations generate data or rely on software. Many deliver services online. In order to run software and store data, organisations can choose to host their own IT infrastructure on the premises, or to rely on the managed services of a cloud provider. Either way, software runs on data centres that organise pools of processing, memory and storage resources.

Modern data centres conform to the 'pod and core' design pattern. Pods are units of hardware (compute, storage, network) platforms and applications. Each pod is deployed, automated and retired as a unit. The core is a highly connected network of switches that support both external traffic from/to the internet and internal traffic across pods within the data centre.

The premise of the 'pod and core' design pattern is that data centres are warehouse-scale computers. As Barroso et al., in their book 'The Datacenter as a Computer', said: 'Large portions of the hardware and software resources in these facilities must work in concert to efficiently deliver good levels of Internet service performance, something that can only be achieved by a holistic approach to their design and deployment'.

There is an intrinsic limitation to running software in a warehouse-scale computer: data must be transferred from the place where it is generated to the data centre and then the results of the processing must be transferred from the data centre to the place where data is needed. This is acceptable for traditional smartphone apps, where the amount of data exchanged is quite limited, as long as network connectivity is good, and assuming we ignore privacy concerns. However, if we care about privacy, or the volume of data transferred is very large (autonomous vehicles, traffic systems, Internet of Things, for instance) or if connectivity is intermittent, then it makes sense to consider data centres that reside at the edge of the internet.

At the edge of the internet, appliances (computers that combine hardware and software components) can be introduced to process data locally, thus avoiding data movement to and from warehouse-scale data centres. Such computers constitute the so-called fog computing or edge computing layer. For instance, Netflix proposes to install customised appliances on the premises of internet service providers (ISPs) in order to accelerate the delivery of Netflix content. This way, customers of an ISP equipped with a Netflix appliance can access movies and series locally, without accessing the centralised Amazon cloud services on which Netflix content usually reside.

Orkney Cloud considers the opportunity to create *community-led managed cloud services at the edge, where the internet is thin, but the social networks are thick – and the environmental resource to power data processing is huge*. But, what kind of data centre should these cloud services run on?

Let us review the conditions in Orkney:

1. Cable-based connectivity to the internet and power sources are excellent.
2. Cable-based connectivity to the internet is centralised in two places (the endpoint of the Northern Lights cable in Skaill and a landing point at the the Ayre of Cara for SHEFA-2 connection between the Faroe islands and Scotland – see map below).
3. Renewable power sources are distributed throughout the archipelago's (actively managed) smart grid and owned by various communities.
4. Data is generated throughout the islands.
5. Users of online services are distributed island-wide.
6. External temperature is cool on average (8.1°C) with low variability (between 2-16°C). It rains often and there is a lot of wind.

These conditions suggest that it is not a good idea to consider a warehouse-scale data centre in Orkney. Such a data centre could be placed in such a way that it has excellent connectivity to the internet, but it would not benefit users of online services throughout the archipelago. It would not leverage existing power sources and would not be an effective way to process or store the data generated in the islands. As a centralised data centre, it would not support efficient community-led and managed services.

We propose a decentralised Orkney Cloud Data Centre, composed of appliances co-located with existing renewable power sources throughout the archipelago. Each appliance, or cluster of appliances, would be owned by the community that owns the power source. Each community could decide on the hardware and software components that should compose the appliance(s) they own. These appliances would store the data generated locally and provide online services to the local users. Some services could be provided based on local data only, others would require data from other appliances in Orkney, while a third category of service would also require data and services.

Submarine Cable Map image: TeleGeography www.submarinecablemap.com

The challenges for such a decentralised data centre are the following:

1 Network connectivity. The only way to interconnect appliances is via wireless links. This requires a wireless infrastructure, based on antennas (either directional antennas for a single wireless link or sector antennas that cover several antennas in a limited geographic area) and possibly repeaters that receive and retransmit wireless signals in case direct line of sight cannot be achieved. This is based on the principles that underlie the wireless infrastructure that Cloudnet already provides in Orkney. What we propose goes beyond the interconnection of access points to the internet; we propose to build a wireless core that interconnects appliances throughout the decentralised data centre.

2 Direct connection to renewable power source. Each appliance should be directly plugged onto a renewable power source. As a result, each should be equipped with batteries and a power conditioning subsystem that provides the stable power it requires.

3 Intermittent uptime. Each appliance might be down at any point in time due to hardware failure, software bugs, power shortages or maintenance. However, we can assume that such downtime is not correlated across appliances throughout Orkney. As a result, it is feasible to introduce redundancy across appliances so that a user can access data or a service even if the appliance she usually gets it from is momentarily unavailable. How to negotiate and implement such redundancy across communities is an open question.

4 Pooling of resources across appliances. Redundancy is necessary to guarantee that a service remains available even when a given appliance is down. However, this assumes that a single appliance has enough resources (computing, memory or storage) to provide a given service. Some services might require more resources than are available on a given appliance. In this case, it should be possible to pool resources across appliances. Existing systems such as IPFS, Tahoe LAFS, GlusterFS or Infinit, provide solutions for pooling decentralised resources. Such solutions need to be evaluated and compared. How to negotiate and implement resource pooling across communities is an open issue.

5 Appliances as pods. Each appliance, or cluster of appliances, constitute the equivalent of a data centre pod. It should be deployed, automated and retired as a unit. How this can be done effectively in Orkney is a fascinating open issue.

6 Environment-friendly pods. Appliances should leave a minimal footprint on the environment. Renewable power and natural resources should be used for cooling purposes. Defining what such a minimal footprint is and how to achieve it are open questions.

We have defined a vision for a decentralised data centre in Orkney composed of community-owned appliances co-located with renewable power sources and interconnected via wireless links. We have also identified a collection of technical and socio-technical open issues that need to be resolved before this vision becomes a reality.

Can community-owned appliances enable Orcadians to shape an environmentally-friendly cloud infrastructure that fits their needs, just as they did with the energy infrastructure? Is it, indeed, a different problem? What is striking in Orkney is the visibility of the energy infrastructure and how both problems and solutions are so present in people's conversations. Is a similar level of awareness needed for the emergence of community-led data services? Many questions, still unanswered, in this issue of Orkney Cloud – already looking forward to the next issue!

Philippe Bonnet is an experimental computer scientist with a background in database management. He is Professor of Computer Science at IT University of Copenhagen, with focus on programmable storage devices.

‘ The network topology is not the same as the social topology.’

Fieldnote, Orkney Cloud Forum meeting.

Green Marine's gantry barge, serving marine renewables photo: Iain Ashman

enterprise

A day in the life of an islands' ISP

Setting up an archipelago 'Internet of Things' network

GREG WHITTON and NIKKI LINKLATER

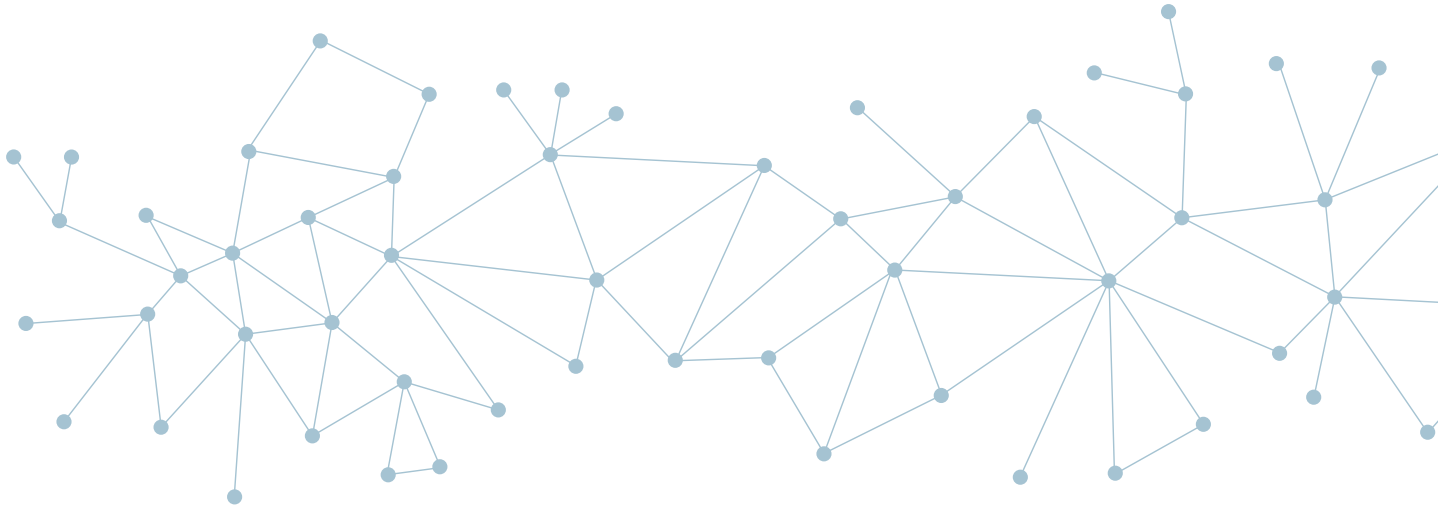
Why did you decide to setup a LoRa network in Orkney?

We recognised that communications in Orkney are reliant on good connectivity, and people often perceive that there is good 3G/4G coverage (with data potentials) on the islands that will cater for everyone's needs. However, through our experience, this isn't the case. Even browsing the internet or messaging (Facebook/WhatsApp) would not work, and we found that there were further data needs for systems/solutions which the current network could not offer. Hence the introduction of LoRA. These further applications are more SCADA/LoRa based solutions, which can deliver a data network outwith the mobile operators and could benefit many more companies/sectors where there is a need for monitoring of data. We also knew that many of these sectors could not necessarily afford the data costs from mobile operators. Additionally, we also undersood that MNOs would not be as flexible or able to provide solutions in areas outwith their coverage ranges, because it would not be cost effective to do so. Through our partnership arrangements, we knew that the 'Internet of Things' could fill this gap, so we set out to deliver a network that we could deploy and let everyone use.

What did you expect to be the greatest challenge, and how was that different to the actual challenge?

The greatest challenge for us to get the solutions in place was to firstly understand the technology, and then to get a better understanding of the requirements. Knowing communications, and having worked in TV White Spaces (TVWS) projects previously, along with building an islands' microwave network, we understood the need for connectivity, in order to deliver a connected site. Whilst we understood these elements, it was having the ability to then make sure we had a LoRa network capable of connecting into our infrastructure. As it turned out, the connectivity was the easy part. The challenges were working with the IoT suppliers of the equipment, and trying to determine the most appropriate LoRa solution for Orkney. We were getting a lot of conflicting messages from the suppliers as to which solution was the best, most cost effective, and what was the most established solution out there. Due to these companies being based in Europe, communication was more difficult. They did not understand what our intentions were, where Orkney is, and that we have an archipelago of islands. We got the sense they were more interested in sales than the technology being fit for our purpose.

The technology is rapidly growing and changing, so there were difficult choices to make. Having made the choice, and because this is an evolving technology, we also encountered difficulties with the 'glue' that links all components together. With the range of companies being bought over and the fluidity of services being offered, this all made it difficult to finalise a platform to connect to. However, having experts from the IT University of Copenhagen to ask for advice, who would talk



to us and share their experiences and knowledge, made it easier for us to move forward. Through this we proceeded with our Kerlink IoT Gateway with the 'things' network for connectivity.

What was the most memorable moment in the installation of the network?

In a few words, the most memorable moment for us was the sense of achievement and defying the sceptics. Orkney and Shetland are very fortunate in having great island communities, as well as ambition to deliver where many are unable to do so. For example, internet connectivity. Whilst this is now an everyday thing, we are still reliant on good connectivity. Across many parts of Scotland and into urban areas, connectivity is often not the best, but it is perceived as such.

We (CloudNet) set out initially to deliver an internet solution on the passenger ferries serving the North Isles. This was (for us) just something we needed to do, not only because it was a novel idea, but because we knew solutions on the ferries were non-existent. Buses and trains had solutions already, but our ferries did not. We delivered with the help and support of Orkney Islands Council and Orkney Ferries, and their continued support is critical to this solution.

When we carried out the installations on the ferries we always had to be aware of our timescales since we could only do the work when the ferry was tied up alongside Kirkwall Pier. There were a couple of occasions when we were literally picking up our tools and running off the ship, with seconds to spare before the ferry pulled away from the linkspan. We would have had up to a five-hour round trip back to Kirkwall! Not a journey we wanted to do if we didn't need to.

How does installing LoRa compare to your daily life in CloudNet, installing and maintaining network equipment?

The installation was extremely straightforward. The solution is not as complicated as when you need to install a microwave link between two sites. The gateway comprises a small box, about the size of two sugar bags end-to-end, which needed to be secured to a high point. We chose the highest location we knew of to give us the best coverage across Orkney. All we needed to do then was run a cable up the mast (for power and data), fix the box securely to the tower, and plug it in.

The exciting part for CloudNet was knowing we were one of the most northerly LoRa installations in Scotland, which we feel proud to have achieved, and to be at the forefront of the technology. Not even the mobile network operators have equipment installed as far north. We like that.

Daily life for us is more about ensuring we have an operational network. Nikki has put CloudNet through its paces lately, getting us accredited to ISO 9001:2015 standards. We felt this would give us credibility in our everyday life, also ensuring processes and procedures are in place to keep our network up-to-date. For us, everyday life is looking

to provide broadband services to those homes and businesses that struggle with connectivity, whilst monitoring and maintaining the network and keeping a watchful eye on the systems to make sure we are fully operational.

We embrace and welcome innovation and new projects, since we strangely enjoy challenges and feel a sense of achievement when developing new technology. We aspire to provide solutions where there is a need, whether it is for a business or a rural household. There is satisfaction at the end of a working day, especially when large corporations are trying to deliver the same.

Where's your favourite place to work in Orkney, and why?

Simple. We call this our office for the day: it is when you are working on a mast or tower, on a sunny, still day with no clouds. It's like standing on top of the world, and gives you that 360-degree view no office window can offer. And being up so high is unique. Not many folk can do that in Orkney. It's special. We often share our photos on Facebook of our office for the day.

How do you think CloudNet and its approach to being an ISP might compare to other ISPs? How does being in Orkney make a difference to what you do?

To be honest we do not know any differently, so understanding how an ISP in central Scotland approaches their everyday work is hard to know. We are aware that being on an island possibly makes you more self-sufficient. If you need a company from south to carry out a piece of work this can become costly and time-consuming, so we have trained in many areas to ensure we do not have to face these issues. We have learnt how to deal with the weather, not just working in it but ensuring that the equipment we use is sturdy enough to battle gales and horizontal rain! We understand how time-consuming some work may be due to the extra travel, such as ferry journeys, and once you are out on an island you don't want to have forgotten anything. These are all things we take for granted but possibly an ISP on mainland Scotland would not have to think about them.

What do you hope LoRa will enable you to do in Orkney in the future?

LoRa is adding future communications to our portfolio. We are here to provide local communications in our islands, and it's our future. Often large corporations like to come in and deliver, based on a numbers game, and remote communities and islands, such as ourselves, are often left behind. For us, it's about being able to deliver to our communities, and our islands. Many find it hard to believe, but if we can look to providing a solution here locally, this is providing local support to local solutions.

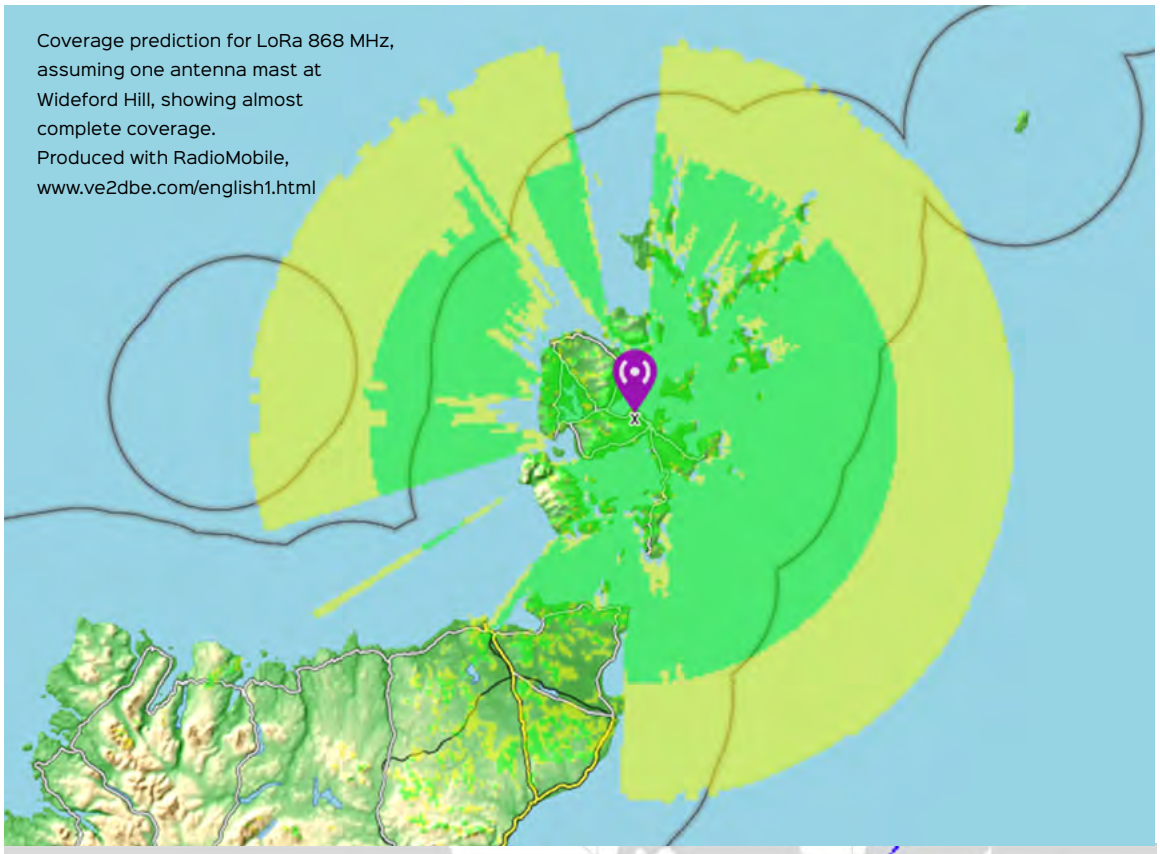
We hope by doing LoRa here we can demonstrate to anyone who wants to do something that they can achieve it, and be competitive in any market, if there is a niche. In essence we hope that LoRa will provide us with a sustainable service and allow us to work alongside the mobile network operators, council, private and public sector bodies, to deliver services for the islands of Orkney, and be a service provider anyone can use.

It's our ambition to be the LoRAWAN network operator for the North Isles, which includes Shetland.

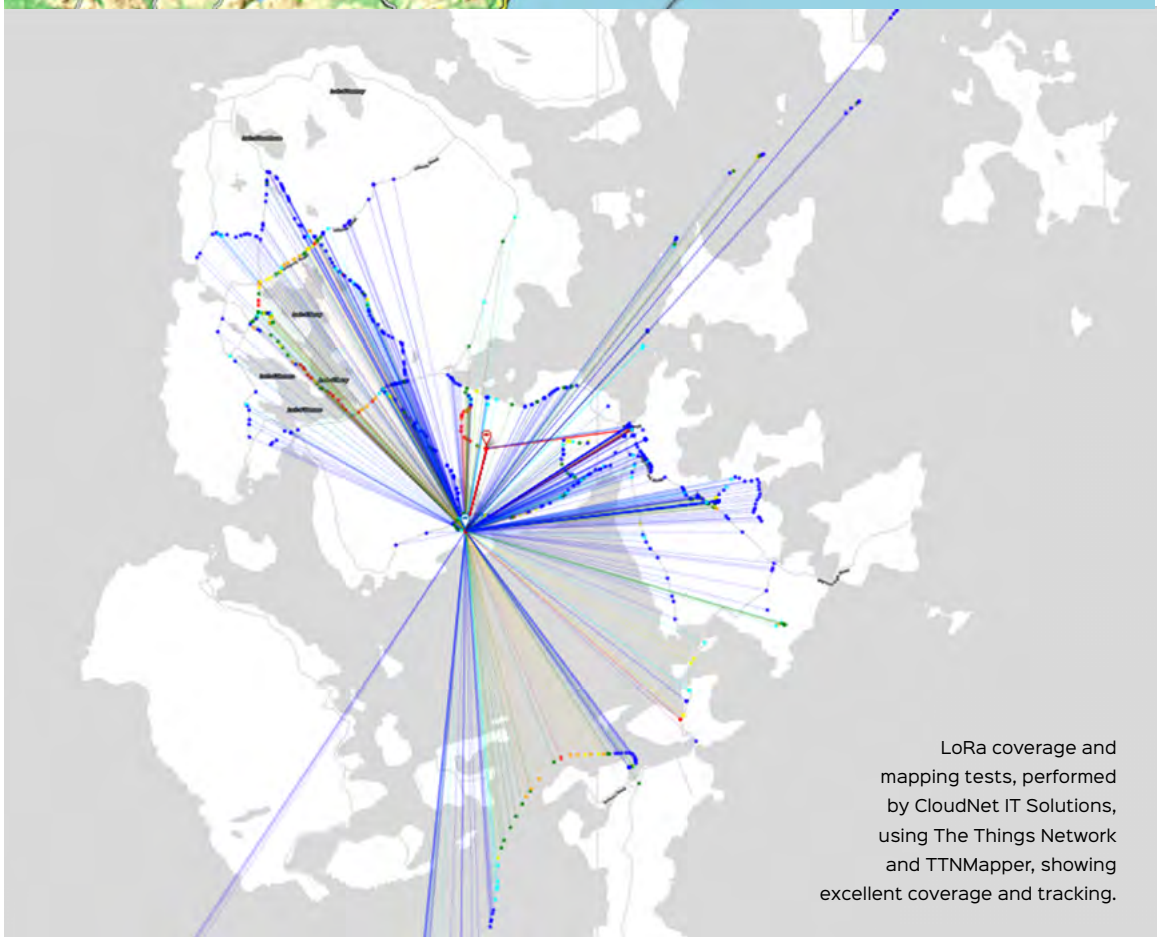
What are you, as CloudNet, looking forward to in the future more generally? What do you dream could happen in Orkney with networking?

In short, 5G, and looking to the future and aspirations for networking, fibre connectivity and sustainability. Being a local company delivering local services to our own community, and working with national providers.

CloudNet are a wireless internet service provider (WISP) providing broadband services to difficult and hard to reach areas, where traditional broadband services fail to deliver. **www.cloudnetsolutions.co.uk**



Coverage prediction for LoRa 868 MHz, assuming one antenna mast at Wideford Hill, showing almost complete coverage. Produced with RadioMobile, www.ve2dbe.com/english1.html



LoRa coverage and mapping tests, performed by CloudNet IT Solutions, using The Things Network and TTNMapper, showing excellent coverage and tracking.

vision

Remote Sensing – from seabed to desktop

DUNCAN CLARKE

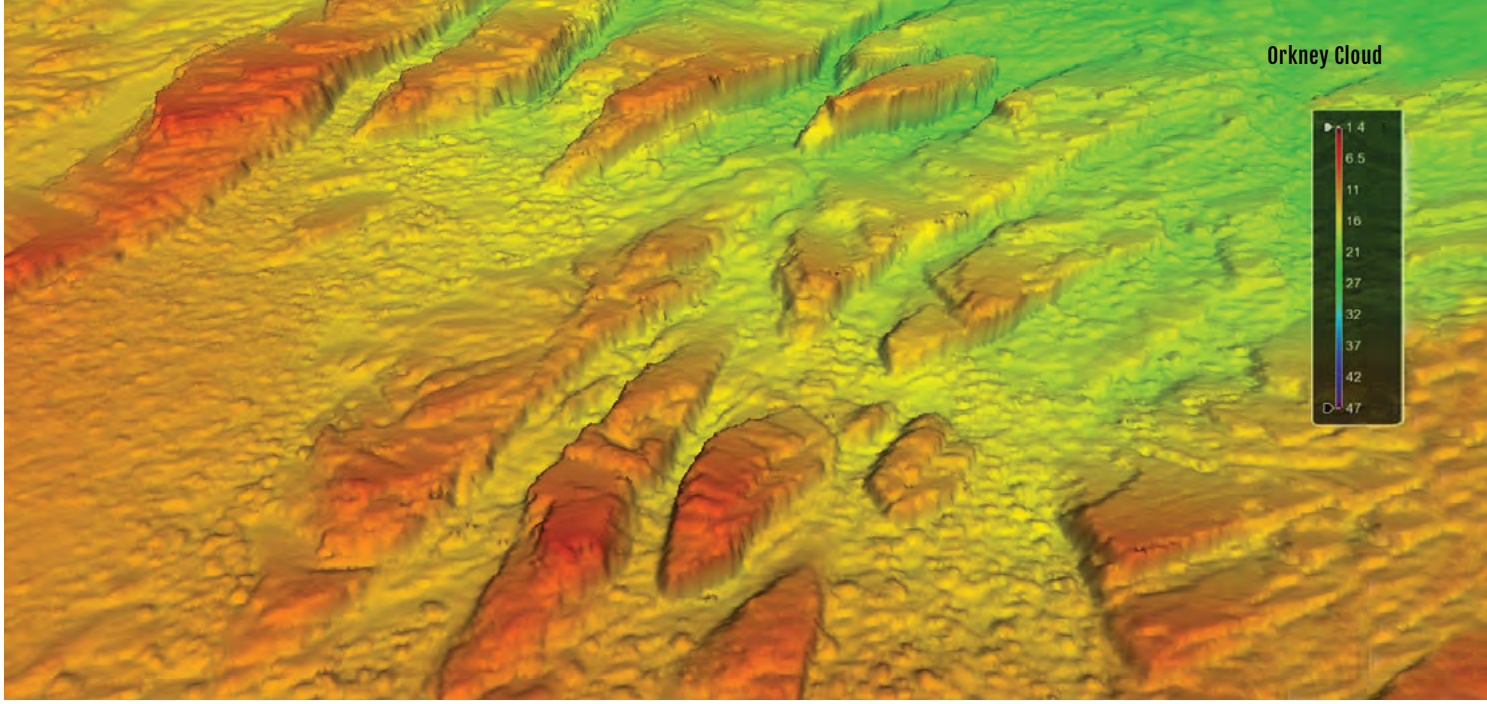
It is often said that humans knows more about space than what lies at the bottom of the ocean. Now, from my own experiences I can't say how relevant that statement is, as I have never had to obtain data from outside the earth's atmosphere. However, I can conclude that it is far easier for me to obtain physical and environmental data from the dry side of the high water mark than it is from the wet side.

My role at Aquatera, an environmental consultancy in Stromness, is as the head of the GIS team. GIS stands for Geographic Information System and is a tool used to work with spatial data, both in terms of displaying them via charts and maps, but also interrogating them, looking for patterns, or finding optimal locations for development.

One of the biggest challenges we face is obtaining data. Often we're relying on data from previous surveys, or buying in from other companies or government agencies. There are instances though, when, for an area of interest, data may not exist, it may be of poor quality, or it may be out of date and not valid for scientific purposes. In these circumstances we need to head out from the comfort of our desks and obtain our own data. Terrestrially, this may be sending out a botanist to identify vegetation as part of a habitat survey, an ornithologist to record flight lines, or a geologist to look at peat depths.

In the marine environment, it is often more difficult to have a human carry out similar observations. We can send divers down to take videos and photography, and obtain samples, we can make use of ROVs (Remotely Operated Vehicles) to obtain video and photography, or we can deploy fixed cameras underwater to record footage over an extended period of time. There are other aspects of marine surveys, especially related to the geophysical and oceanographic sciences where it is not feasible for information to be recorded by human observation. For example, we may need to record water depths using bathymetric survey equipment, wave regimes by deploying wave rider buoys, sediment types by using vessel-mounted sidescan equipment, tidal currents using ADCPs (Acoustic Doppler Current Profilers).

The need for obtaining some of the most hard-to-get data has driven the development of technology, and has raised the question as to whether technology development could also aid those fields where human observers are more often deployed. Often, surveyors are required to venture out into remote areas that are not always easily accessible and may pose risks due to their remoteness and often lone-working environment. Satellite imagery and aerial photography have become far more obtainable to everyone over recent years, and these data sets are already used to look at habitat change and map habitat types. With the advancement of technology, could a camera system be developed that observes birds, identifies their species, and calculates their distance and height? The present method still involves a surveyor with a pencil and a map estimating height and distance, before handing over their maps to a GIS technician to trace their annotated maps into a digital format.



Mapping Orkney's seabed topography Image: EMEC

In the marine environment the need to obtain information of physical and oceanographic processes has led to the development of various sensing technologies over the years. This has allowed for incredibly detailed images of the seabed to be created, compared to the methods of 'plumbing the depths' every so often to get an estimate of depth. More is now known about tidal streams and their behaviours through the use of ADCPs. Not only can we now measure the patterns of tidal flows in terms of speed and direction, but can also look at how these patterns differ throughout the water column.

Despite all these advancements in technology, there are still aspects that delay us. Marine surveys can often take place a long distance from shore, and even where the survey sites are located near the coast the surveys may require equipment to be deployed on site for weeks, months, or even years at a time. In the case of ADCP surveys, the ADCP units are deployed on the seabed and left to record for at least one full tidal cycle. Once the survey period is completed, the units are recovered, transported back to port and the data extracted. It is not unknown for a unit to be recovered and on downloading the data find that it has not recorded, or for the unit to get moved and not be recording the water column above it. This means there can be weeks, or months, where you're crossing your fingers to make sure everything is going okay 50m down, and, even all being well, you still have no data until the unit has been physically recovered.

Imagine though if there were a way of using some form of communication that could relay this data in near real time back to the comfort of your office or lab. There would be no more unknowns about whether the device is working properly, you could tell if it was still in the correct alignment, and you could work with data in small chunks, rather than wading through months' worth of data at once.

Elsewhere (see page 40) we've seen how CloudNet have made use of LoRA networks to provide internet access to remote users off the fibre grid. What is stopping us from making use of these wireless networks to send data directly back ashore from marine sites? Of course there are issues that will need to be resolved, including getting a signal from a watertight unit sitting below water to the surface to enable communication. There is also the issue of the amount of data to be carried. Data from an ADCP is entirely text-based and easily transmitted, but if we were looking to transmit live video footage from an underwater camera via a wireless signal then a different approach may be needed.

As an island archipelago at the forefront of the marine renewables industry, marine monitoring is an important part of various industries operating in Orkney. We have the European Marine Energy test Centre (EMEC), the Flotta terminal handling oil and gas operations in Scapa Flow, a thriving aquaculture industry. And we have a harbour authority that has to manage and monitor the waters in relation to operations at Flotta, including ship-to-ship transfers of oil and ballast water

Deploying ROV for seabed investigation photo: Mike Brookes-Roper

transfers, and is also in charge of the largest cruise port (in terms of number of visiting ships) in Scotland.

As ever, as a community at the forefront of innovation, there are plans within Orkney to set up a test bed where various marine monitoring devices can be located and wireless communication methods tested in a controlled environment. Who knows, in a few years, marine surveying and monitoring worldwide may become a little more cost efficient and automated thanks to testing being carried out off the north of Scotland.

Although I work in the marine industry, I should not forget how some of the above could also help out with other prominent industries within Orkney, namely cultural heritage, agriculture and tourism.

Orkney is home to some of the best-preserved Neolithic sites in northern Europe, has architectural and cultural links to the Vikings, and was a prominent location in the Second World War. New sites are being discovered and more automated sensing and data communication can also provide support to the archaeologists and academics in the field. The Orkney Research Centre for Archaeology (ORCA) are already making use of novel sensing methods to locate and document sites throughout the islands. They currently have a team of volunteers that send in photographs of coastal sites simply taken with their smartphones, from which they can piece together and create 3D models, observing how coastal erosion is affecting these sites over the years. The next steps are to make use of drones and use stills from continuous video footage to cover larger areas. There are even plans to attempt similar approaches underwater using ROV footage. If photos and video could be instantly shared with ORCA, then directions as to where new images should be obtained could be given within minutes, rather than days, after waiting for footage to be delivered and then requests being sent back out.

In the agriculture sector, sensors recording soil condition could help determine the best time to harvest crops. The simple use of remote video cameras to observe byres during the lambing and calving seasons could allow farmers (and their families) to get some sleep rather than constantly watching their animals.

With regards to tourism, there is a strong link to Orkney's cultural heritage. Hundreds of thousands of visitors come to the islands every year, arriving

as private parties by land or sea, as groups on coaches, or thousands at once on some of the larger cruise ships that visit. On certain days in the summer, when multiple large boats arrive in Orkney, the population of the archipelago rises by around 25%. Tour operators have to bring extra transportation across the Pentland Firth, and plan exact timings with military precision, to ensure that all the guests off the cruise ships don't trip over each other at the numerous sites.

What about all the other holiday-makers enjoying Orkney during the peak cruise season? There are still hundreds of private groups on family holidays that also want to visit these famous sites. At the moment it's just 'luck of the draw' as to whether they find Skara Brae peaceful and quiet, or if they find it filled with passengers from the five tour buses that have all arrived at that time.

At this point another aspect of remote surveying and communication comes to the fore. What if there was an app that linked in to the known booking systems so they knew when peak periods would occur? An app that communicated with footfall sensors at each site to let them know whether a site was busy or quiet. All this technology exists in the Internet of Things; it just needs a strong community of public and private businesses to agree on a communal way forward.

The outside world may look on Orkney as a peaceful quiet rural location, a slow pace of life, often voted as one of the best places to live in Britain; but what many don't see are the advances that are being made in marine renewables, innovative technology development and utilisation, and the desire and ability of the islands' people to make things happen, when it feels as if those south aren't doing enough.

Orkney has always been a forward-thinking place. We had some of the world's first wind turbines, set up the world's first marine energy test centre, carried out pioneering vessel-to-vessel fuel transfers, whilst all the while acknowledging and cherishing our rich history. What better place than Orkney for testing and developing the next generation of remote sensing technology and applications?

EMEC's Integrated Monitoring Pod photo: Colin Keldie, courtesy EMEC.

Duncan Clarke is Head of GIS and Data Management at Aquatera Ltd, based in Stromness, Orkney. He works on Aquatera's data management tools and its marine surveying activities.

empower

Solo Energy and the Virtual Power Plant

MARK HAMILTON

The year is 2020, I am in my little cottage in Stronsay, overlooking the white sandy beaches of Whitehall. My 9kW wind turbine has been running for about an hour, which has provided enough energy to heat my cosy living room for a couple of hours. Tonight, however, the energy is being used by my old friend, Dave, who had earlier this evening pinged me to send him some energy tokens. Dave, who lives a few miles south of London, then proceeds to charge his electric vehicle as he finishes planning his annual summer trip up to the northern isles. The tokens of energy I send him are much cheaper than they are down south, plus he wants to ensure all the energy he uses is from a renewable energy resource, of which there are plenty to choose from up here in the far north. Who wouldn't want some low cost energy from a fully renewables-powered island with the largest virtual power plant in the world, powered by a combination of wind, wave and tidal energy?

Whilst this situation is a future-based scenario – it raises some very real questions for today. How is it even possible to send electrons across the North Sea, all the way to a borough in London? How is it that I can choose which power source I want to support through my use? Are there real problems that we are trying to solve? These and many more questions are being answered every day by brilliant minds working on systems that have in-built intelligence - hard at work repurposing old centralised systems into decentralised networks of the future. All the technologies behind what is being termed as the '4th Industrial Revolution' are powered by two key systems: cloud computing and blockchain. Developments in these areas have led to cloud-provided, connected computing, and payment and identity security, creating the perfect confluence of technology for interconnected communities.

Cloud computing brings together software development platforms, servers, storage and software over the internet, facilitating a distributed architecture. A subsequent integration of a blockchain layer provides a means of tracking and storing data transactions, which can be tokenised and traded on a blockchain-enabled payment platform. Digital assets with independent writers are now providing immutable records, that can be accessed, traced and linked to show ownership and existence of smart assets which can be used as a representation of real-life assets.

There is no doubt that the blockchain technology is going to speed us into the next technological era precisely because of its decentralised nature. And energy, the most vital of all industries, is potentially the sector where it will have one of the biggest impacts. Across the world, international corporations are working on trial projects based on blockchain, which are at the heart of interconnectivity; whether it's a relationship between prosumers (producers and consumers) or the provision of an unmediated last-mile link between the energy suppliers and the consumers.

With blockchain, we have the opportunity to essentially re-imagine how we interact with

energy in the future, particularly when it comes to renewable sources. Blockchain enables the simplification of today's highly complex system, creating a new reality where producers of power, transmitters, distributors and suppliers can interact on a new, closer to consumer, level, enabling far smaller players to enter the market. With the tokenisation of energy, individuals can be both producers and consumers (prosumers), which will lead to the creation of DEMs (Decentralised Energy Markets), where excess energy is traded on a peer-to-peer level.

Another interesting way in which we can see how blockchain is being applied is securitisation. Securitisation enables small players to participate in a large asset pool. In the development of a decentralised energy transaction and supply system, guaranteeing the authenticity of all the players and their assets is critical, as well as capturing all the important flows of information in a secure and immutable way, such as metering and billing information.

Solo Energy's distributed battery assets capitalise on cloud infrastructure where a reliable service is able to call on distributed batteries to either charge or discharge from the local electricity network depending on the needs of that network. For instance, at Solo Energy, by tokenising the energy flows of home batteries and electric Vehicle-to-Grid (V2G) chargers across the grid network, a Virtual Power Plant (VPP) comprising several thousand flexible energy storage assets can be created and deployed at the grid edge.

Orkney – a test bed for the future.

In marginal locations such as the islands of Orkney, localised mesh networks provide an opportunity for interconnection and power aggregation in distributed systems. Coupled with multiple generation assets across the landscape (and seascape), the local community has grown to appreciate the benefits of distributed computing via local energy networks on the blockchain. Integration of digital assets on the virtual instance provides multiple layers such as distributed batteries colluding as infrastructure as a service (IaaS), the trading of kwh units between peers through a platform as a service (PaaS) and the use of Solo's FlexiGrid control platform as software as a service (SaaS).

Digital smart assets are allowing the scaling of human independence and, paradoxically, interdependence, by using these tools of creation of capital, connectivity, and efficient markets, all aimed at the individual.

Solo Energy is building the power plant of the future – the Virtual Power Plant. We believe in a future that is powered by 100% renewable energy and blockchain. We are creating that future now.

Solar panels and Tesla Powerwall batteries installed on affordable homes, Kirkwall
photos: Mark Hamilton

Mark Hamilton is a visionary renewable energy entrepreneur with 14 years of management, commercial and engineering experience in renewable tech. He co-founded Solo Energy with a passionate belief that the world will transition from fossil fuels to 100% sustainable energy within our lifetime, and is determined to make that happen through disruptive application of energy storage and blockchain in the energy sector.

The three masts serving Orkney on Wideford Hill, Kirkwall photos: Iain Ashman

‘ ...when you are working on a mast or tower, on a sunny, still day with no clouds, it’s like standing on top of the world... It’s special.’

Greg Whitton, Nikki Linklater, CloudNet

communicate

Building your own internet – community networking

SEBASTIAN BÜTTRICH

The year is 2005. A small group of people ride the waves in a little boat off the coast of Zanzibar. One man is holding a strange object – it looks like a tin can? – pointing it at the horizon. And they seem to be talking into a laptop microphone.

Zanzibar, 2005 photo: Sebastian Büttrich

Are those people crazy?
Far from it.

They are testing the reach of Wi-Fi signals, in order to bring connectivity to remote and disconnected places, and in fact they are having a video talk with one of the funders of the project, from a boat on the Indian Ocean to Canada.

Thirteen years on, and access to broadband internet - and the opportunities that come with it - are still far from equally spread over the world. Regions get left behind for various reasons. Typically, because they are remote and thinly populated, or places that are hard to reach. But even in big cities, quarters are forgotten or neglected in the planning.

And around the globe, people have understood that it does not have to be that way - that you can actually change it yourself, by very simple and affordable means.

Mostly, it is wireless networking in the so-called unlicensed frequency bands that comes to the rescue. Most of us know this as Wi-Fi, and are using it at home or work, or in cafes, libraries and airports.

But what most people do not know is that Wi-Fi can easily go for miles - many miles in fact! The current world record stands at 237 miles.

Not everybody wants to go that far, but doing one mile or 10 miles is relatively simple and inexpensive. Community networks around the world have used this approach to bring wireless broadband to rural households.

How does one do that?
It typically involves connecting a stronger antenna to a standard Wi-Fi access point, and putting that in a window or on a roof, as high up as possible, and pointing it at the other end. The other end can be a neighbour who has good internet, or a local internet service provider's antenna tower, or a public place willing to share connectivity.

The Freifunk-Initiative installing Wi-Fi antennas in Berlin-Kreuzberg, 2013
photo: Boris Niehaus (JUST) www.commons.wikimedia.org/wiki/File:Freifunk-Initiative_in_Berlin-Kreuzberg.jpg

Antennas can be bought, or, if you enjoy a bit of do-it-youself, they can be built from scrap metal, empty cans, old TV dishes and so forth. And not only are these DIY antennas useful – it's also great fun gathering a group of people and building them together!

Guides on how to do this are freely available, for example here, in the Green Book: **www.wndw.net;** or in a video we made for the Danish DIY movement in 2005: **youtu.be/prTKZXoTLgQ**

Cantenna building, SA cantenna
photo: Sebastian Büttrich

A pair of simple can antennas, or Cantennas, can go five to ten miles, if done properly.

But, I hear you say, who is paying for this? If I am sharing my bandwidth, am I not giving my internet away, for free?

That is completely up to you!

Neighbours may share a connection and split the costs, making it cheaper for everybody, or you can organise a little local sharing group where all members pay a little monthly fee. Whatever works - works! A good ISP will support such initiatives.

But then, would this really improve the situation in Orkney? Surely it is difficult to get good internet connectivity because we are on a group of remote islands?

In fact, the islands have very good submarine cables reaching them, with a lot of capacity. And there are several of them (see map on p. 37). We just need to get the signal out to the people – which is where the Wi-Fi magic comes in.

Of course there is also the possibility of using fibre, and, wherever that is available, it is the fastest and best internet you can get. But it is also more expensive, and difficult to do, unless you are lucky enough to live close to where there is already fibre.

Many community networks around the world use a mix of fibre and Wi-Fi, with fibre as the backbone, and Wi-Fi connections to get to the individual households. It is not one-size-fits-all: some of us are fine with basic internet, others want a super highway.

The good things is, all of this can be done, and you can do it yourself, for little money.

And, as a last bonus, you can run the whole network on renewable energy, be it solar, wind or ocean energy. And what better place to do this than ...

Exactly!

Installation of a 'supernode' in the guifi.net network, Tarragona, Catalonia

‘If you need something, you make it; if it breaks, you fix it.’

François Matarasso ‘Stories and Fables: Reflections on culture development in Orkney’, 2012.

Sebastian Büttrich is a physicist turned wireless networker, free technologist, solar, wind and hydro energist, biker, noisemaker, wordlover, who works with embedded/pervasive systems, wireless technology, open source/free software and solar energy.

Stones, Ring of Brodgar photo: Duncan Clarke

solutions

Digital Blacksmith

Your community expert 'forging' a way to fix your IT

DUNCAN CLARKE, LAURA WATTS, GREG WHITTON and NIKKI LINKLATER

The science fiction author, Douglas Adams, once said: 'Anything invented before your 15th birthday is the order of nature. Anything invented between your 15th and 35th birthday is new and exciting. Anything invented after that day, however, is against nature and should be prohibited.' Although a little stereotyped, it still resonates. Those who have grown up with routers and browsers are sometimes asked for IT support by those for whom it is new, which often involves trying stuff out with the nagging worry that you, as unofficial IT support, might 'brick' the computer.

Orkney, as with many rural locations, has a population dip from around the age teenagers leave to go to study and retirees arrive to enjoy the landscape. There is a large number of people for whom the internet arrived after their 35th birthday, and a dynamic cohort of young people who take being online for granted, but might not have acquired the technical skills to know how to maintain connectivity.

Those who live in the islands are very reliant on IT infrastructure, perhaps even more so than in other places. It provides crucial connection to basic services; telemedicine is being trialled here, for obvious reasons. Many people run their own small business and/or a local organisation. Farmers, fishers, art festivals, tourist tours, museums, wind turbine companies; these island organisations need a reliable internet connection and end-to-end IT infrastructure so that they can focus on their work, and benefit their local community. But these organisations are based on islands with sometimes fewer than a hundred people, so there is often no one with the expertise to ask for help, and it can take weeks for engineers from south to book a whole day (sometimes two) to take a ferry out to fix the problem. Remote support is no use when your internet and phone connection are down in the first place, and your mobile phone signal only works through the top floor window of your stone house. (Stories are told of islanders running backwards and forwards between talking to IT support on their mobile phone in one room, and their router and computer in the other.)

As with much else, the expectations of urban IT companies often do not hold true in these 'edge' locations. Basic assumptions about infrastructure, that an engineer can just drive to a house, or mobile phone signal is pervasive, cannot be assumed in edge locations like Orkney. Here, infrastructures are visible and not taken for granted.

So, there are two problems: low density of expertise, and infrastructure precarity. IT education and infrastructure development initiatives are ongoing, but both are taking their time to reach the places and people who need them most. Both could be addressed by on-island experts who could share their IT knowledge around the community, and be on hand to fix problems. In the 'Orkney Way' of

‘There are always experts hiding in the woodwork in Orkney.’

Fieldnote, Orkney Cloud Forum, lunch break.

Rural connectivity photo: Sebastian Büttrich

approaching problems with self-determination, Cloudnet (the Orkney ISP) has proposed a solution to do just that: the Digital Blacksmith.

What is a Digital Blacksmith?
The vision for a Digital Blacksmith is to have a person, or small team, plugged into the heart of a local community, who can foster local digital skills. The Digital Blacksmith is a 'weel kent' (Orcadian for 'well-known') face on the island, who has the skills and tools to fix everyday IT problems, just as a local blacksmith would have fixed metal technology in the past. They would have two main purposes: to harness digital technology for the benefit of islanders (individuals and organisations); and to share and promote IT knowledge, from getting online to hackathons to coding classes.

Such experts have appeared in other places of infrastructure precarity: local repair shops with skilled IT fixers abound in places from Lima to Hyderabad*. But the Orkney Digital Blacksmith would be more than an IT fixer. They would help local businesses get more out of digital communications, assist with marketing of products and services, and provide training and seminars.

The digital 'forge'
A traditional blacksmith had a local workshop or forge, and a Digital Blacksmith's 'forge' would be a welcoming and inclusive drop-in centre, a gathering place where ideas could be sparked and nurtured. For example, somewhere to bring your laptop to be fixed, as well as a place to embrace software development and coding, or to provide hands-on assistance with website and app creation for local businesses.

The island IT forge would be a hub, stimulating interest and awareness of digital tech throughout the community. It would be a place for digital apprentices to learn, in collaboration with the local island school. (Remote teaching is already a feature of the universities in Orkney, so perhaps this could be incorporated.) It could be a venue for seminars, encouraging and facilitating island IT projects. And the forge could be a place for external companies to visit, to brainstorm IT challenges in beautiful surroundings at the edge, and to share knowledge with local communities, who often have expertise in energy infrastructure.

The forge might have a cafe (existing cafe businesses could be invited to provide facilities);

* For more on repair cultures around the world, see **www.continentcontinent.cc/index.php/continent/issue/view/27**

Hoy from Marwick photo: Iain Ashman

a studio for crafting video and podcasts; regular events and workshops, and apprentice training programmes – even a FabLab, in time. The forge might start off a few days a week, setting up shop in an existing building on the island. Always it would be looking to support and develop existing island business and opportunities, so each Digital Blacksmith would be implemented differently in each place.

Developing Digital Blacksmiths in Orkney

The Digital Blacksmith is in the inception phase, and we have been exploring what needs to happen to make it a reality. First up, the right person to be a Digital Blacksmith needs to be found. Interested?

Those outside Orkney might imagine that the challenge is a lack of qualified candidates. Visitors may leave with the idea of a simple quiet life, slow-paced, and not the sort of place to find skilled IT professionals. However, it is almost the opposite problem. Orkney has a high level of employment, meaning that even though there are numerous qualified individuals, they are already committed, with limited time and availability. Orkney is an unusual place. Spend a few months here and you'll discover people who think so far outside the box that you forget there is a box. It is a necessary aspect of living in a small and remote community: with no one to call on you have to teach yourself, and solve your own problems in ways never attempted before. There is an enormous diversity of expertise. Within Orkney there are people fully capable of being a Digital Blacksmith; the issue is that they are already busy and moving fast (we slowed some down enough to take the time to contribute to this magazine).

So, we have to think further outside our own box. We are considering a team of volunteers, or a single apprentice attached to an existing IT company, who could head out to a different island or area once a month or so. We could use the existing community centres as our temporary forges. We're looking at funding to compensate Digital Blacksmiths for their time and travel. We know, in Orkney, one way or another, it will happen.

Laura Watts is a writer, poet, ethnographer of futures, and Interdisciplinary Senior Lecturer at University of Edinburgh.

Duncan Clarke is Head of Onshore Development at Aquatera Ltd, based in Stromness, Orkney.

Greg Whitton and Nikki Linklater are directors of CloudNet IT Solutions Ltd, Kirkwall, Orkney.

community

‘Great idea – but how do we pay for it?’

Solutions for better internet connectivity to remote islands

CARL MULLINS

That's the thing – sometimes the easiest question to ask is the hardest to answer. When you consider the vast resources available within developed countries, compared to developing countries, something that appears as simple as delivering high speed internet to particular areas becomes inordinately difficult, because of the cost overlay of distance from main infrastructure, market economics, health and safety, bureaucracy and politics.

Before I took up employment within the International Centre for Island Technology (ICIT), Heriot Watt University, Orkney campus, I spent nearly a year researching the lack of broadband availability on Flotta (one of the less populated islands of Orkney) and developing ideas to address this issue. It isn't as straightforward as running a cable, be it twin copper or fibre optic, but rather a case of understanding why, as yet, nothing substantial has been attempted to address this issue. The current political approach is to wait and see what develops with the R100 Tender - the project being driven by the Scottish Government to provide 100% of premises with internet speeds of 30Mbps before the end of 2021. The bidders for the contract, which is broken into three sectors (southern Scotland, central belt, and highlands & islands), gain points by providing coverage to the more remote areas.

The understanding so far is that even then there will still be approximately 5% of the Scottish population which will not have access to 30Mbps coverage (you'll excuse me if I point out that coverage doesn’t necessarily mean connectivity). So, my main area of concern has been how to

ensure that the 5%, which mainly consists of the non-linked islands/remote communities, get access to internet speed that most people within built up areas now take for granted.

As a starting point, I chose Flotta for the initial study (not just because I live there, but it also happens to be one of the few non-linked isles with a good transport link to mainland Orkney, about 15-30 minutes away by boat). The population is around 80 people, there's a mothballed school, a disused airstrip and it's of a size that's big enough to be a challenge, yet small enough not to take forever to install fibre optic infrastructure. Now you may think, 'sounds easy', so what's the problem? The answer is simply lack of 'back haul' infrastructure, as Flotta is one of the places at the extremity of the existing tree and branch approach currently utilised by service providers (in this case, BT Openreach). Almost every approach I've heard about so far becomes unstuck because of the sheer cost of laying infrastructure to provide connectivity to the 'back haul' and thus provide an internet service. This is certainly one of the major obstacles, but it seems that most people soon lose the will to persevere in their attempts to gain internet access due to insurmountable bureaucracy, lack of co-ordinated thinking by infrastructure providers, and a tendency to adopt a 'wait and see' approach and hope someone else will address the issue.

This has been pretty much the approach for the last twenty years at a time when some island communities are failing due to lack of work opportunities for youngsters, which leads to them leaving to work elsewhere and often never returning. There is very little or no interest from businesses to start up in these locations as they are unable to compete partly due to the poor/no internet connectivity. Using Flotta as a case in point: there is little/no population on the island between the ages of 18-50.

Having used the spare time whilst looking for work to start to hold conversations with multiple stakeholders, representing both public and private bodies, I built up a very good understanding, not just of the obstacles to overcome, but also what is potentially available to make things happen. The willingness is certainly there within all parties, but in a lot of cases it seemed to me like it's a problem which most would class as 'someone else's responsibility'. It might have been possible to get away with that argument a few years ago, but not now. Technology has moved on and improved, and there's now recognition within both the Scottish and UK Governments that island communities need to approach things in a different way to the mainland, hence the introduction and passing of the 'Islands' Bill' within parliament.

With that in mind, I put all the information and ideas down and, with encouragement from the ICIT academic staff, gave a presentation on how to approach this. This went up the chain of command within the university and I was told 'this could actually work – not just for Orkney, but for other Scottish islands and other remote communities as well'. The overall idea is to utilise renewable energy technology, to an extent, to drive local fibre nodes within each island community. The approach will be a research and feasibility study to start with, to identify potential technology and partners, then to work on a proof of concept. By installing fibre to the premises (also known as FTTP) via a local node, it removes another frequent problem: any premises more than two kilometres from a cabinet currently fed via twin copper suffers a severe drop in broadband internet speed due to attenuation from the cable.

Flotta from Stanger Head photo: Iain Ashman

The task is not so much being able to provide superior internet connectivity immediately, but recognising that there is no reason why we couldn't get the non-linked islands internet-ready, utilise existing back haul technology for the moment, then upgrade to better technology as the opportunity arises. One opportunity could be to utilise new subsea national grid power cabling installations, since they are continually being laid to provide capacity for wind turbine power generation.

On the actual installation side I'm working in partnership with others to set up a social enterprise operating as a separate entity, to provide practical on-the-job/life skills training and work opportunities for former servicemen (as they already have good skills) and disadvantaged youngsters. An installation project of this type is going to be finite, so why not provide the training and education in such a way as to allow candidates to gain further employment at the end of the project? Skills such as driving and map reading are transferrable, as are hand and plant tools and equipment, and individual and team discipline. Of course there are still matters to attend to, such as a training location, residential living and working, securing payment for their efforts, equipment and suitable vehicles. I know for a fact that the funding is available to address the 5% separately, it's ensuring that the installation is done to enhance the efforts of the eventual R100 bid winner, not as a 'stand alone' system. I'm also a great believer that if public money needs to be spent, you should get the biggest bang for your buck.

How we pay for it is still a relevant question. So far, the answer is 'we're working on it'.

Social Enterprise Mission Statement

It will need to be recognised from an early point that the idea is to ensure that the candidates involved within the fibre infrastructure project (former servicemen and the disadvantaged youngsters) are paid for their efforts. They are going to have to work hard and pay their own way from what they earn. This isn't about giving them a handout, but a hand up. At the end of one year, the aim is for them to have their own tools, PPE/Work clothing, have learned to drive if they can't already, have saved enough to supply their own transport and be leaving with both certification and work experience in more than one skill group, enabling them to work and live as an islander if they so choose.

This is achievable

Carl Mullins is a former infantry signals instructor with over 30 years' experience of radio communications, commercial satellite communications, corporate audio visual and IT support within his skillset.

'The idea of mutual assistance is very important to Orkney's society.'

François Matarasso: 'Stories and Fables: Reflections on culture development in Orkney', 2012.

‘ What is striking in Orkney is... how both problems and solutions are so present in people's conversations.’

Philippe Bonnet, IT University of Copenhagen

Hoy from the ferry photo: Iain Ashman

words

Invisible lines

GROUP POEM

Stromness cumulo-nimbus.
Warmed harbour water
under poetic feet

Words blown like leaves
shift and gather

Beneath Tender Tables
I see the face
of the tide

The line between hydro poles
mimics the horizon

How do we measure
what we are
and do?

Shares, likes and tweets.
The raising of megaliths.

Building up and tearing down
a framework for the peas
a riposte from the wind

She wraps the boulder on the beach
in silver foil

Bodies transformed
sheathed in water
and light

A flicker of stripes
a leap into my lap

Mother and child
at the Knap of Howar
held by invisible lines

The air speaks
with forked antenna-tongue

A satellite dish
collapsed into rust –
it might be for the best

Accumulations of snow
gather hither

The garden's forgetting
no bees
in the fuchsia

Post-turkey swadging
with Indiana Jones

The narrative fragmented
streaming
in fits and starts

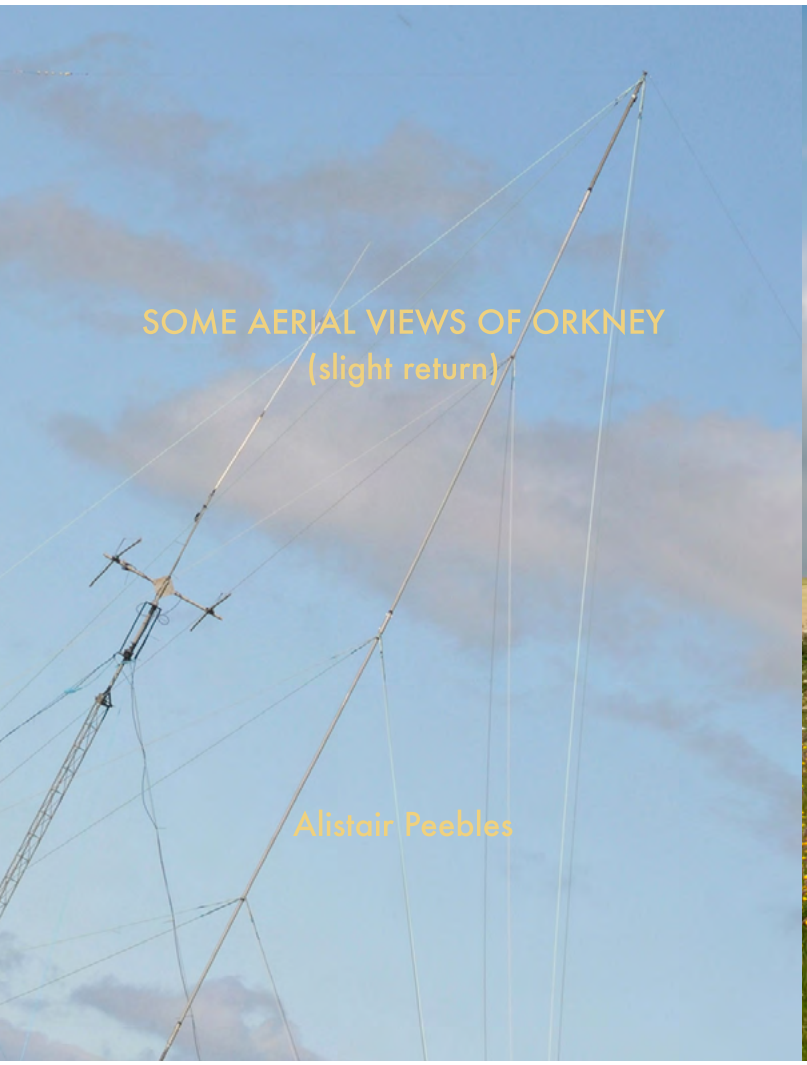
Hydrogen blossoms
is pressed into bars

Printed bunting
from Africa
wavers on black railings

A new beginning?
Time to speak as one.

This renga (a Japanese process of creating a group poem) was written in the Warehouse Buildings, Stromness, on 6 October 2018.

Sylvia Hays, Yvonne Gray, Pamela Beasant (master), Duncan and Laurel Clarke, Laura Watts, Becky Ford



This series of images and texts comprises an edited version of the 32-page concertina book *Some Aerial Views of Orkney*. Along with a front and back cover, each magazine page may be imagined as representing two sides of the original. The photographs were taken by Alistair Peebles, between 2008-14, and the texts derive from his email conversation in early 2012 – a kind of radio chatter – with a locally-based electronics engineer, the words selected all being either the engineer's own or those of a former colleague. The idea for the book derived from an interest in the increasing presence at that time of new vertical structures (chiefly wind turbines) within the low-lying islands' generally horizontal topography, the comparative invisibility of existing radio masts providing a curious visual foil.

Some Aerial Views of Orkney is expected to be published in 2019 by Brae Editions.

WE used to climb to the top of the radio mast at Warsetter. Some folk would tie rags around the red light at the top to dim it, as a kind of a mark of having been up the tower. The big dishes faced Wideford, in Mainland, in one direction, and other big dishes faced Sumburgh in Shetland. There are many smaller dishes on the mast now, feeding local circuits.

All I remember of Decca is 'mo-ro-go-po' which is what the Shipmate receiver display said when it got no reception: Master=0 Red=0 Green=0 Purple=0, I presume.

The first time I ever went commercial fishing (1993) the digital Decca navigator onboard was working. I distinctly remember the green glow of the display at night. That was the only time I remember it in use.

The other one I remember is that Hifix transmitter stations were manned 24 hours for reliability, so the station minder or minders would live on site, often in a caravan.

I sailed with a guy who had spent time on the station at Bodham near Peterhead. He said the antenna – 2 MHz or thereabouts, which was quite a big structure – sat over an earth mat. Something that was essential.

One of his tasks was to make sure it was working properly by watering it frequently and copiously. In part, this necessitated nightly trips to the boozer, after which the earth mat worked extraordinarily well!

The Decca you remember is almost certainly Mainchain which the fishermen used. Some of the early oil & gas rigs were put in with Mainchain which I think had some form of lane ident. The lanes were very wide of course so Hifix was brought in to provide extra precision. The same hyperbolic patterns were produced, and you bought Admiralty charts with Hifix patterns superimposed.

The big snag with Hifix was that you had to start from a known point, and set in the lane numbers on dials which were like a car odometer. You then went to sea and watched the dials as they counted, logging once a minute to make sure there was no slippage. It was a tedious job.

When snow fell you would get a line of static charge in front of it, which would upset the patterns. The snow could be near or far off. Sometimes snow on a station, say in Norway, would cause a shift. If this occurred the dials would sometimes spin like mad making a whirring noise. If you were lucky you might manage to set the dials back, but just in case this sort of thing happened, you would drop danbuoys at regular intervals so that you could come back to a known point.

A favourite trick was to walk up behind the surveyor and simulate the whirring sound of spinning dials – drove them crazy.

I was a survey tech too albeit in much more modern ships. The boredom on long survey trips is legendary, and pranks were indeed elaborate. A sense of humour definitely an essential item of equipment!

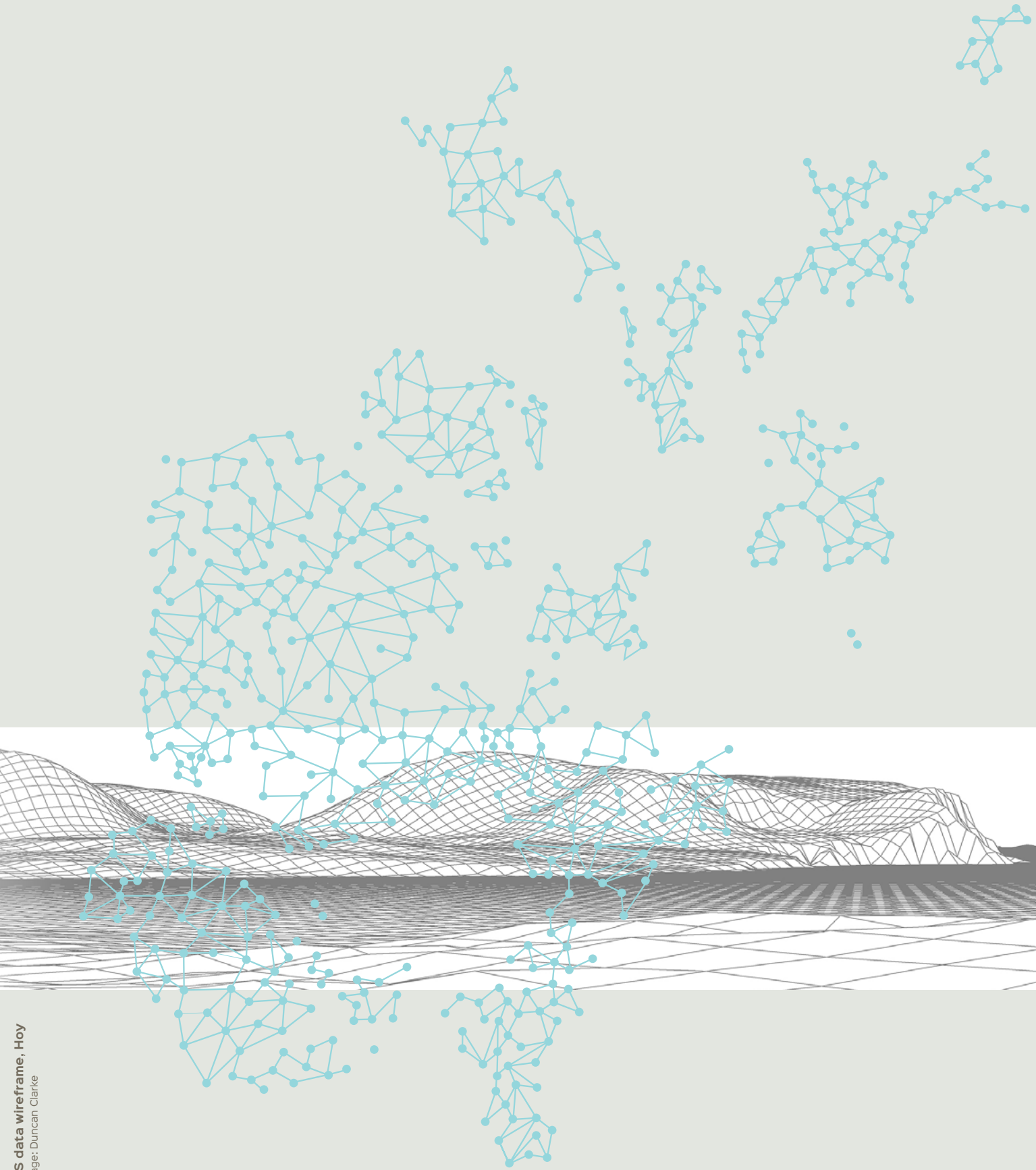
It does make you wonder though, the ubiquity of GPS is just a given now, enabling virtually free-of-charge position fixing to a few meters. But it wasn't always so!

Alistair Peebles (b. 1953) is a writer, and as Brae Editions, an occasional publisher. Originally from the Forth valley in central Scotland, he has lived in Orkney with his family since 1985. He is currently at work on a biography of the Scottish poet, artist and gardener, Ian Hamilton Finlay.

‘Re-invent this subtle, parallel place, that makes north true, possible, outlined.’

Pamela Beasant, Orkney poet.

Marwick Head photo: Iain Ashman



GIS data wireframe, Hoy
image: Duncan Clarke

‘Orkney shows how much can be achieved and how. It remains an example that other communities can learn from, if not imitate.’

François Matarasso, ‘Stories and Fables: Reflections on culture development in Orkney’, 2012.

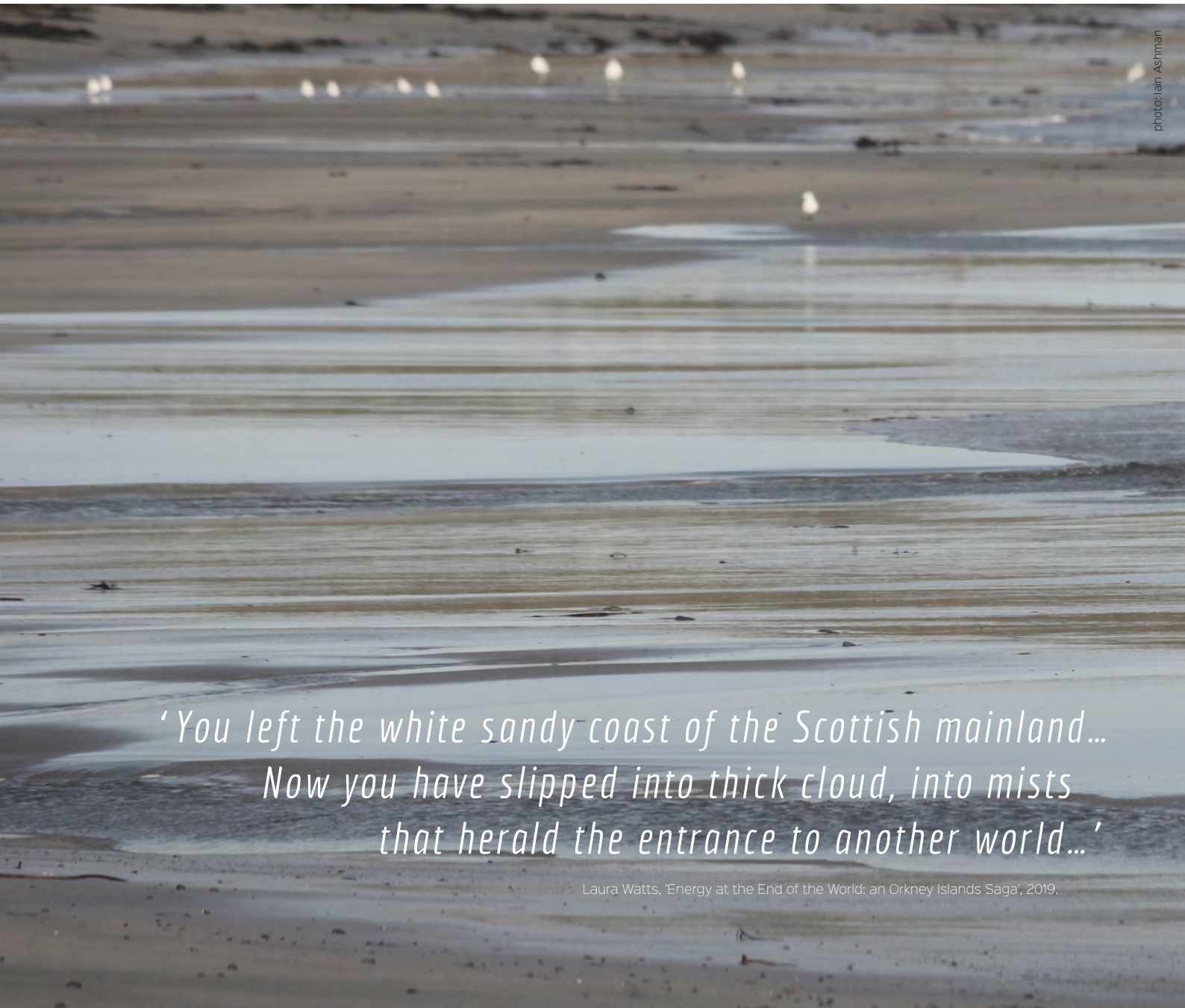


photo: Iain Ashman

‘You left the white sandy coast of the Scottish mainland… Now you have slipped into thick cloud, into mists that herald the entrance to another world…’

Laura Watts, ‘Energy at the End of the World: an Orkney Islands Saga’, 2019.