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GOOD ENERGY PRACTICES GUIDE

Northern Periphery and Arctic Programme
2014–2020

EUROPEAN UNION
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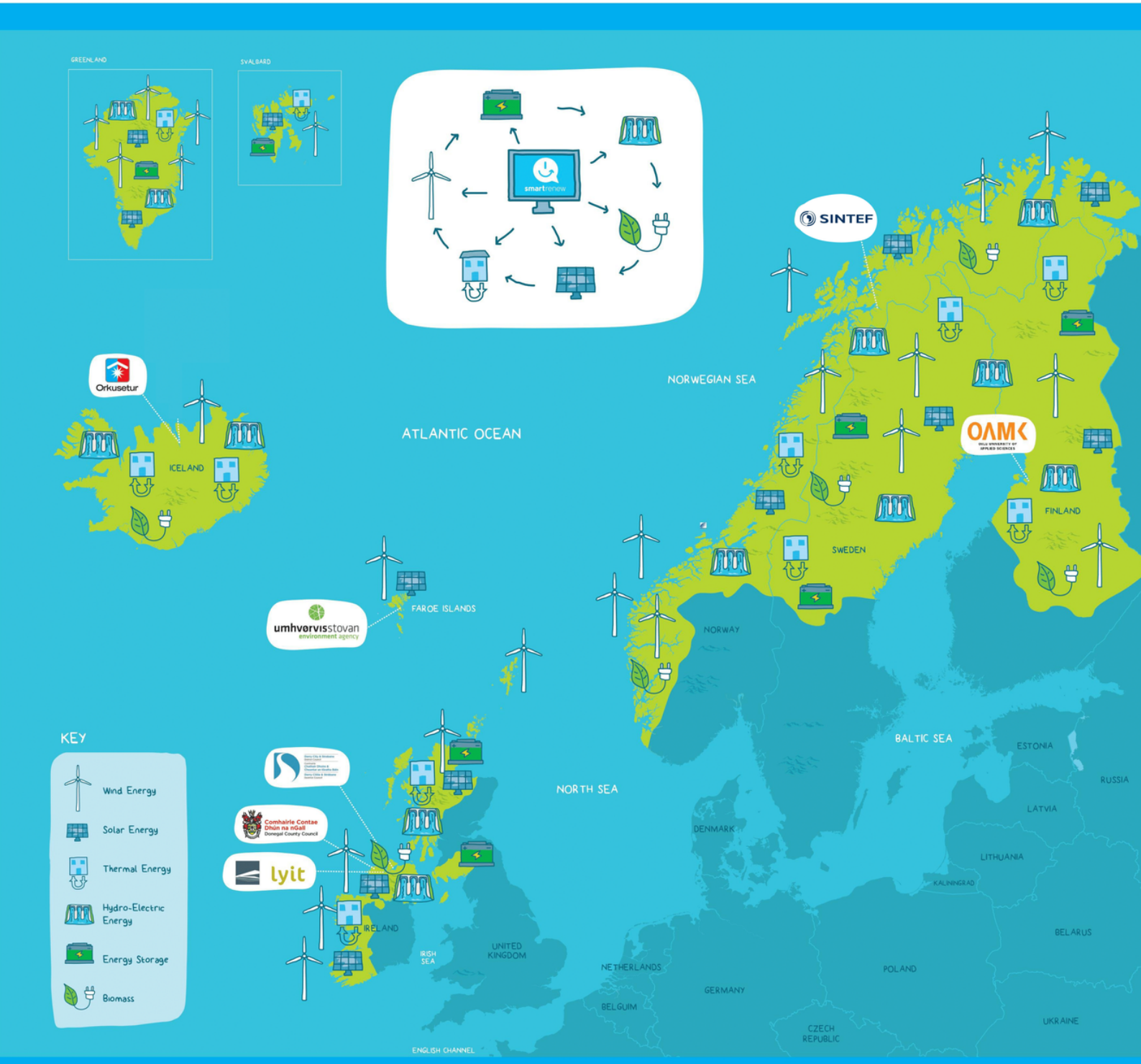
Growing Sustainable Energy Communities



Smarter Renewable Energy and Heating Management for Arctic and Northern Rural Territories

lyit

Orkusetur
www.orkusetur.is

umhvørvisstovan
environment agency

SINTEF

Comhairle Contae Dhún na nGall
Donegal County Council

OAMK
OULU UNIVERSITY OF APPLIED SCIENCES

Derry City & Strabane District Council
Comhairle Chathair Dhoire & Cheantar an tSratha Báin
Derry Cittie & Stràbane Destrick Cooncil

INTRODUCTION

Project SMARTrenew is part-funded by the Northern Periphery and Arctic (NPA) Interreg programme of 2014-2020.

The main objective of SMARTrenew is to transfer and implement innovative renewable energy and smart storage solutions across housing and public buildings to 6 dispersed regions of the NPA, each with varying levels of renewable energy maturity – Faroe Islands, Finland, Iceland, Ireland, Northern Ireland, and Norway.

There are 7 organisations involved in SMARTrenew including academic, research, local authorities and national energy organisations, each with complementary experience, knowledge and competence in renewable energy sources and energy storage solutions.

The SMARTrenew partners include:

- LYIT- Ireland
- Derry City & Strabane District Council- Northern Ireland
- Donegal County Council- Ireland
- Oulu University of Applied Sciences- Finland
- Orkusetur Energy Agency- Iceland
- SINTEF Research Institute- Norway
- Umhvørvisstovan- Faroe Islands

The primary aim of SMARTrenew is to utilise the cooperation of each partnership involved, between higher and lower levels of energy maturity, to increase the awareness and implementation of smarter renewable energy sources and energy storage solutions.

Key to the project sustainability and growth beyond the project duration will be promotion of stakeholder ownership in these pilot innovations including influencing local and national policy-makers to effect change.

CHALLENGES

The common territorial challenges addressed by SMARTrenew include:

- Cold climates- leading to fuel poverty
- Low population densities- 6 inhabitants per km
- Over reliance on fossil fuels- leading to fuel insecurity
- Low connectivity and accessibility
- Renewable energy often produces more than what is required by local populations
- Energy storage is underdeveloped
- Temperatures are rising higher and faster in the Arctic region than the rest of the world

LETTERKENNY INSTITUTE OF TECHNOLOGY

Donegal, Ireland

Solar Powered Electric Vehicle Charging with Battery Storage

BACKGROUND

Ireland has made strong commitments to carbon neutrality by 2050, including a target of 1 million electric vehicles by 2030, with the potential to save 3 million tonnes of carbon each year.

However several barriers have inhibited EV growth and the rollout remains slower than anticipated with domestic car usage still 90% fossil fuel powered. One of the key challenges in EV rollout in Ireland is access to reliable charging infrastructure and the issue is a lot more prominent in rural, peripheral communities with car ownership higher than in urban areas, where public transport is more accessible. Nearly 40% of households in Donegal, northwest Ireland, own at least two cars.

Furthermore, Ireland is behind in meeting renewable energy targets, with one of the lowest shares of energy from renewable sources among EU member states. This pilot will showcase and increase renewable energy and energy storage innovation and awareness in the wider community, while also addressing the infrastructural challenges in the electrification of transport in Ireland.

PILOT

The LYIT pilot will showcase a solar array combined with battery storage to facilitate slow charging stations, aimed at the all-day electric vehicle parker, powered by renewable energy. The 10 KW PV array is situated in the LYIT campus carpark with bifacial PV panels, a 10KWh battery and a 22KW dual EV charger.

Furthermore, a display meter dashboard will be installed inside the main LYIT Campus building, which will showcase to staff, students and other stakeholders, the power savings and usage of the facilities over the project lifespan, highlighting the cost benefit analysis.

IMPACT

- Showcasing the benefits of renewable energy and energy storage in the wider community
- Less reliance on fossil fuels sources to power electric vehicles
- Increasing the uptake of electric vehicles in rural communities with high private transport ownership
- Cost savings

Solar powered EV charging in Donegal, Ireland

ORKUSETUR ENERGY AGENCY

Grimsey, Iceland

Replacement of Diesel Power with Wind Turbines, Solar & Battery Solutions

BACKGROUND

Although Iceland is almost 100% powered by renewable energy, the Grimsey islanders (61 inhabitants) still use oil for electricity generation and heating purposes as due to the distance from mainland Iceland, Grimsey is not connected to the renewable electricity grid.

Under SMARTrenew, a roadmap to the full replacement of diesel power on the island was developed, where several hundred kW wind turbines are installed, together with water heaters and electrical batteries, providing the required power load and energy storage.

Overall electric energy production in Iceland is 19.828.868 MWh. The corresponding production in Grimsey is 795 MWh, or 0.004 %. Although small, there is a need replace it.

PILOT

Under SMARTrenew, wind turbines and solar PV in Grimsey were utilised to replace diesel systems. This marks a firm step towards green energy on the island. A battery storage solution (refurbished electric vehicle battery) was also conceptualised.

The SMARTrenew pilot involved switching to LED lighting and integrating two 6 kW wind turbines together with a 12 kw solar PV unit and a 24 kWh refurbished EV battery. The wind-solar-battery SMARTrenew pilot solution, integrates into the existing energy system and provides a path towards a fully renewable society on the island, thereby eliminating the final 'black spot' in the otherwise fully renewable energy system across Iceland.

under SMARTreOrkusetur also developed a design concept for heat extraction from cold sea, down to 1°C, for the town of Seyðisfjörður, East Iceland, for future adoption.

IMPACT

- Involved stakeholders around the country and provided a path forward for rural communities in Iceland
- Participated in re-writing government contract for energy supply in Grimsey - a prerequisite for the addition of renewable energy to the existing diesel generation system
- Analysed energy use and proposed heating solutions for Seydisfjordur and Grimsey
- Eliminated the reliance on fossil fuels in Grimsey Island

Removal of an oil tank in Grimsey, Iceland

OULU UNIVERSITY OF APPLIED SCIENCES

Oulu, Finland

Heat Storage & Geothermal for District Heating & Hydrogen Competence Mapping

BACKGROUND

EVO is the water and energy co-operative that is responsible for district heating, water treatment, and clean water distribution in Kuusamo, Finland. In the downtown area of Kuusamo, the district heating is produced at the Toranki CHP plant and at the Ruka biopower plant.

When the CHP and biopower plants cannot generate enough heat to cover the energy needs of the entire customer base, EVO needs to use its oil burning, auxiliary boilers to generate the additional heat.

In the current district heating system in Kuusamo, the main plant produces the required heat using mainly wood based fuel, however during very cold weather, the heat production is insufficient to meet heat demands and auxiliary systems are used which are operated with oil-based fuel.

PILOT

Under SMARTrenew, Oamk, together with Evo, is piloting a major heat storage solution for district heating in Kuusamo, Finland with the installation of a 500 m3 heat storage tank. This energy storage solution will shift dependence from oil to renewable fuel in peak periods. The system also functions as a backup in case of power plant or pipeline failures, thus making the district heating network more stable.

A calculator is also being developed to help optimize heat storage usage by predicting hourly network power demands and highlighting peak usage times. This data can then be used by the operator to optimise heat storage use.

Oamk has also set up a Hydrogen Working Group under SMARTrenew, to roadmap competence to greater future hydrogen utilisation in Finland and has completed preparatory works on the feasibility of mid-deep geothermal powered district heating in the Kirkkosaari area of Muhos village, Finland, where zoning for a new housing and community development is underway.

IMPACT

- Showcasing the benefits of renewable energy and energy storage in the wider community
- Removal of fossil fuel reliance and utilisation of carbon free renewable fuel
- System can act as a stable backup in times of pipeline failures
- Cost savings

Energy and Water Co-operative (EVO) in Kuusamo, Finland

SINTEF RESEARCH INSTITUTE

Narvik, Norway

Remote Monitoring of Energy Consumption in Off-Grid Households

BACKGROUND

The SINTEF SMARTrenew pilot aims to broaden the energy mix across off-grid households in Norway, where there is an increasing interest in renewable systems, high grid-connection fees in remote areas (>50 000 €), and a lack of energy security and grid independence.

Supply of renewable energy during the winter months is challenging with households needing to significantly reduce their consumption and forgo energy intensive activities.

The focus of the SINTEF SMARTrenew pilot is to improve the wintertime comfort and reliability for these off-grid households.

PILOT

The SINTEF SMARTrenew pilot solution combines remote monitoring of solar, wind, temperature, and energy consumption, to reach an optimal off-grid solution, utilizing a mix of renewable technologies in Norway. The pilot explores building off-grid capabilities, reducing energy costs, and developing back-up power solutions, across off-grid households.

There are two families in the Lofoten area who are aiming for complete off-grid solutions to meet their energy needs. Under SMARTrenew, SINTEF are collaborating with a local SME company to install a sensor solution for these households, to log detailed weather data documenting solar output, wind generation and temperature.

Based on the measurements and simulations, this pilot will result in a report for householders with recommendations for adjustments, expansions and next steps. The report will outline the most effective energy mix solution for these off-grid households during the winter months.

For the broader audience, the results will be a showcase of the possibilities of living off-grid in far north locations which could be transferred to other similar locations.

IMPACT

- Showcasing off-grid living solutions for households
- Providing recommendations to off-grid households for greater energy security during the winter months
- Reducing energy costs
- Identifying best practice in the utilisation of renewable energy solutions

Off-grid house of the Seierstad family in Norway

DONEGAL COUNTY COUNCIL

Donegal, Ireland

Retrofit of Public Buildings with Heat Pumps, Solar Array & Cavity Insulation

BACKGROUND

The pilot actions of SMARTrenew partners, Donegal County Council, a local authority, aims at the improvement of energy efficiency in the heating system of a municipal Public Services Centre and community library in Donegal, Northwest Ireland.

The building, constructed in 2003, with a total floor area of 20,000 sqft, provides for many public and community services such as the Public Library, the Citizens Information office and various Donegal County Council community services. The space and water heating was provided by 2 oil fired boilers which were over 18 years old and serving 5 radiator circuits, an under-floor circuit and a DHW circuit to the building.

Raw data collection prior to the pilot project works indicated an approx. consumption of 18,000 litres of marked gas oil (MGO), per annum, in the building. The largest meeting room within the building is the Council Chamber and the space heating in this room was provided by an external wall mounted, air handling unit, which could not adequately heat the space and therefore additional electric heating was required. The challenge was to retrofit the building with a more energy efficient solution.

PILOT

Donegal Councty Council's SMARTrenew pilot project implemented major energy upgrades to the Milford Public Services Centre and Community Library in 2020 including:

- Three 42.6 kW air-source heat pumps to replace oil boilers
- Twenty photo-voltaic solar panel to generate 6 kW of electricity
- Pumped cavity bead insulation to 800m2 of external walls
- New efficient heating controls and smart live CT meter data of the air-source heat pump consumption

IMPACT

- Providing smart heating and electric control
- Removal of the dependency on heating oil with carbon removal
- Showcasing a smart renewable energy mix
- Cost and energy savings- Over 200,000 kWh saved

Removal of the oil burner at Milford Public Services Centre, Donegal, Ireland

UMHVØRVISSTOVAN ENVIRONMENTAL AGENCY

Faroe Islands

Borehole Energy Storage Combined with Ground Source Heat Pumps

BACKGROUND

The Faroe Islands are remote islands in the middle of the Northeast Atlantic, where 93% of the energy usage derives from imported oil. In a bid to increase renewable energy technologies, wind power is being adopted and oil users are encouraged to electrify their needs.

Due to the high latitude of the islands, space heating is required all year round, accounting for 20% of the total Faroese energy use. To electrify space heating is regarded as a low hanging fruit as electric heat pumps are a developed technology that can replace oil burners.

Although available wind energy corresponds well with required space heating, the fluctuation in wind energy is much higher, with long periods when no wind may be encountered. Therefore, the development of various energy storage technologies is seen as a necessity.

As the Umhvørvisstovan office building was in the process of replacing the oil boiler in favour of a ground source heat pump, it was decided that the Faroese SMARTrenew activities should focus on testing energy storage in the form of a hot water tank, in combination with a geothermal well, as part of the office heating system.

PILOT

- Design of a flexible office building heating system using heat pumps and integrating energy storage
- Drilling of a 400-meter-deep (deeper than usual) ground source energy borehole
- Installation of measurement system for accurate monitoring of heat flow in the system
- Cooperation with geologists and geophysicists at the Faroese Geological Survey for monitoring and modelling heat transport in rock and water
- Development of numeric modelling of heat transmission and heat storage capacity in the ground

IMPACT

- Showcasing the technology and benefits of renewable energy for space heating
- Removing the reliance on oil, increasing environment protection and generating cost savings
- Better understanding of the dynamics and ability of a ground source energy borehole for space heating
- Determining the parameters involved in the numeric model of heat transmission for borehole technologies
- Feasibility of ground source borehole heat storage including mapping the recovery rate of stored heat
- Learnings and insights on the design of future renewable energy heating systems

Construction of a 400 metre deep borehole in Tórshavn, Faroe Islands

DERRY CITY & STRABANE DISTRICT COUNCIL

Northern Ireland

Retrofit of Historic Buildings with Intelligent Energy Efficient Wireless Technology

BACKGROUND

Built in 1882, the historic Harbour House sandstone building, located in Derry City, was originally used as the Londonderry Port and Harbour Commissioner's headquarters. The building is now owned by Derry City and Strabane District Council and is used as office space for democratic services administration within the council.

The building is heated with natural gas and although there is some level of thermostatic control of heat within the building, the heating costs are in the region of £8,000 per annum. An energy audit carried out in November 2018 highlighted inefficient control of heating zones and increased thermal energy use. The challenge for the Council was how it could improve heating control within the historic building, without disrupting the building fabric.

Derry City and Strabane Council worked with local SME, Heatboss, to come up with an innovative, wireless-enabled, smart heating system, that suits the individual requirements of the historic Harbour House building.

PILOT

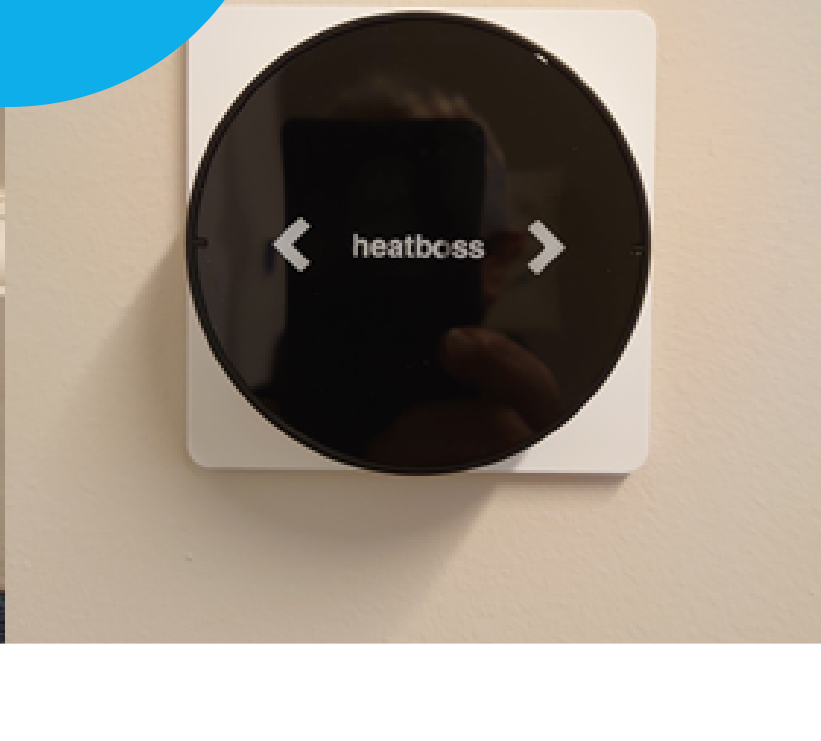
Heatboss wireless devices and web applications enable room level control of heating, which is accessible securely and remotely, from any web enabled device. This enables better efficiency, comfort, and control of heating across large buildings. Ultimately, this leads to a significant reduction in energy consumption, with reported energy savings of approximately 30% in other historic buildings.

Wi-Fi Boosters have been strategically placed around Harbour House to allow each device to fully connect to the internet and each of the radiators have been fitted with a wireless radiator valve so that the heat from the radiators can be turned off and on, when required. Each of the rooms have been fitted with an interactive thermostat which allows room users to control the temperature and controls have been fitted to allow for the Heatboss Wi-Fi hub to interact with the boiler when there is a demand for heat within the building.

IMPACT

- Non-disruptive installation, sympathetic to the fabric of historic buildings
- Enabling customisable comfort levels with individual room control
- Maintaining the integrity of historic buildings while increasing energy efficiency
- Reducing heating usage by 30% using innovative wireless heating controls

Harbour House building, Derry, Northern Ireland, retrofitted with Heatboss wireless controls



The SMARTrenew partners meet in Iceland, 2019

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For more information visit

www.smartrenew.interreg-npa.eu

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