RENEWABLE ENERGY IN RURAL COMMUNITIES... 'IT CAN BE DONE'

12 July 2000
Columba 1400, Staffin
Isle of Skye, Scotland

Dùthchas
Our Place in the Future

Contents

Sowing Seeds of Sustainability with Duthchas

The Dùthchas project was piloted in three communities of rural Scotland. For thirty months - from October 1998 to March 2001 - Dùthchas has been sowing seeds of sustainability in Skye's Trotternish peninsula, North Sutherland and North Uist.

The Duthchas Vision

- To have a clear and strong sense of identity
- To have confidence and believe in ourselves
- To value everybody, and offer everybody the chance to earn a living using their individual talents
- To be positively engaged in creating our own destiny
- To be the enthusiastic guardian of our surrounding natural and cultural inheritance, today and tomorrow
- To aim to deliver local needs locally
- To consider the effects of our actions on future generations
- To identify a realistic way forward for the community.

An rud a bhios na do bhroin, cha bhi e na do thiomhnadh
That which you have wasted will not be there for future generations

"Why don't we do something with all this water and wind?"

The object of the Dùthchas project has been to build a sustainable future on the strength of (1) the resources that we hold within ourselves and (2) the resources that surround us. During the wild, wet winter of 1999, an exasperated man asked the staff of Dùthchas in Trotternish, "Why don't we do something with all this water and wind?"[1]. The question struck a chord and it lent weight to the sound wisdom that exists in our communities.

We endure a great deal of wind and rain on the north and the west coasts of Scotland. Now wouldn't it be satisfying if we got a return from this? Electricity, petrol, coal and oil are all extortionate means of deriving energy in rural Scotland - and don't we know it! Freight on imported goods makes it almost impossible to sustain economic activity of any kind. But wouldn't it be satisfying if we could reduce our cost of living through energy saving schemes?

Since Dùthchas began work in North Uist, Trotternish and North Sutherland, our communities have had a busy time working alongside the project to prepare plans for sustainable solutions – solutions that they, the communities, have decided upon. Each of the three communities selected between four to five issues on which to build new foundations. What was most interesting was that each of the three areas targeted renewable energy as one of the principal issues for delivering a sustainable future. Local "RE" groups were formed in 2000, and their visions are given below.

RE Vision for Skye's Trotternish peninsula – "to be less dependent on external energy by effective use of local resources, to the maximum benefit of the local community"

RE Vision for North Uist - "to use proven and experimental renewable technology to the advantage of North Uist, and make it more energy efficient in the future without damaging the environment"

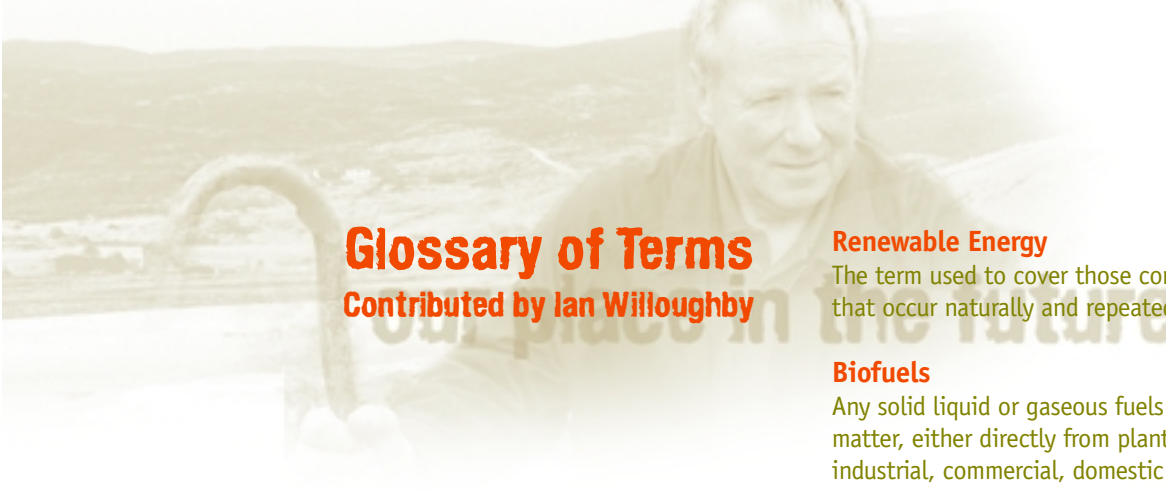
RE Vision for North Sutherland – "Wise stewardship of the land with long term benefits for local communities, achieved through integration of current land management practices"

While our three communities shared an enthusiasm for renewable energy, we lacked hard knowledge about this complex subject. To feed our enthusiasm, Dùthchas hosted a seminar at Columba 1400 in July 2000. We invited experts to share with us the opportunities and challenges of creating our own renewable energy rurally.

The aims of this seminar were to:

- Raise awareness of the wide variety of opportunities that exist for Renewable Energy;
- Whet people's appetite for this topic;
- Give people from the Dùthchas communities an opportunity to meet experts from this field.

Footnote 1 – The Dùthchas community survey, 1998/199 (see the Initial Review)



Glossary of Terms

Contributed by Ian Willoughby

Renewable Energy
The term used to cover those continuous energy flows that occur naturally and repeatedly in the environment.

Biofuels
Any solid liquid or gaseous fuels produced from organic matter, either directly from plants or indirectly from industrial, commercial, domestic or agricultural waste.

Landfill Gas
Methane-rich gas produced by anaerobic digestion of waste in landfill sites and combusted to provide energy.

Energy from Waste
The combustion of domestic, industrial or commercial wastes.

Municipal Solid Waste
Waste products collected from households (which may be used as fuel for power and heat generation).

Industrial and Commercial Waste
Materials collected from industrial and commercial premises (which may be burnt for power and heat generation).

Biomass
Biomass fuels are biofuels produced solely from organic matter, and they include energy crops and forestry and agricultural residues.

Energy Crops
Plants grown specially for use as fuels: for example, willow coppice or miscanthus.

Forestry and Agricultural Residues
By-products of forestry and agricultural operations burnt for energy, such as straw, chicken litter and felling residues. Also covers wet waste such as manure used in anaerobic digestion.

Energy From Water
Using the movement of water to produce power is one of the oldest energy technologies. Today, power is extracted from water in three main ways: through tidal, wave and hydropower devices.

Hydro Power
In hydropower schemes, the turbines that drive the electricity generators are directly powered by water - either from a reservoir, or the “run of the river”.

Tidal Energy

Tides are generated by the gravitational pull of the moon and sun, and tidal power stations operate by capturing the water of tidal rise and then passing it through turbines to generate electricity.

Wave Energy

Waves are created by the passage of the winds over the surface of the sea, and energy is present in their height and movement. Wave power devices are designed to absorb this energy and convert it into electricity.

Fuel Cells

Fuel cells convert the chemical energy of the reaction between a fuel and an oxidant directly into electricity.

Solar Energy

Solar radiation is the ultimate source of energy for the majority of renewable energy sources. The term "solar energy", however, is usually taken to refer only to those energy sources that derive directly from the sun's light and heat.

Passive Solar Design

Employs collectors to capture and store the sun's heat primarily for space and water heating.

Photovoltaics

Involves the direct conversion of light energy from the sun into electricity by means of specially prepared semi-conductors.

Wind

Power can be extracted from the wind by the use of a wind turbine. As air flows over the turbine blades, it creates a turning force on the rotor assembly which can then be used either to drive pumps, for example, or more conveniently to generate electricity.

Wind farms are currently predominantly located onshore, but can potentially be developed in offshore locations. The technology for offshore deployment is similar to that for onshore.

"Let's leave the world a better place than we found it …"

Programme

The Seminar's Proceedings were chaired by Donald MacDonald of Dùthchas in Trotternish

0845	Registration at Columba 1400 & coffee
0915	Introduction to Dùthchas
0930	Assynt: A Community Hydro Scheme by John Mackenzie, Assynt Crofting Trust
1000	Energy Efficiency and Sustainable Housing by Ralph Throp, Scottish Homes
1030	Coffee
1100	Wave Energy by David Langston, Wavegen
1130	Building Design by David Dittman, Ecotech Homes
1200	Government Policy on Renewable Energy by Elaine Hanton, Highlands and Islands Enterprise
1230	The Environment and the Landscape by Caroline Stanton, Scottish Natural Heritage
1300	Lunch
1400	The Dùthchas Visit to Jutland
1430	Biomass Energy – Warmth from Wood by Victoria Sutherland, Torren Heating
1500	Wind Power and Solar by Ian Irvine, Ingenco
1530	Towards a Sustainable Skye by Alexandra Hayles, SERM Rating Agency, Denmark
1600	Coffee and shortbread
1615	Conclusions
1645	Close

Assynt: A Community Hydro Scheme

In 1993, the people of Assynt made history by becoming the first crofters in Scotland to buy their land on the open market. John Mackenzie of the Assynt Crofting Trust was one of the main drivers who made that happen. Since that time, the Assynt Trust has become the catalyst in the drive for Land Reform in Scotland. The Assynt hydro project is a project which has been spearheaded by John himself.

Ladies and Gentlemen, I appreciate the invitation to address you today and I trust that you will find what I have to say both interesting and stimulating, as well as challenging, for I believe there are real opportunities for many of our communities in the generation of electricity from renewable sources. The UK government is committed to sourcing 10% of our energy needs from renewables by 2010, and coupled with this is a commitment to reduce green house gas emissions by 12.5% by 2012, and emissions of carbon monoxide by 20% by 2010. This is an ambitious target and all the more so when it is recognised that today around 3,500 people are employed in the renewables industry by over 700 companies.

I had hoped to be able to tell you that the Assynt Hydro Electric project was now delivering electricity into the grid, but sadly we are not quite there, because of minor technical problems. Construction is complete and we hope to be operational in three weeks time. More of that shortly, however.

The History

Before giving you some details of the project, let me tell you just a little about the Trust itself and how it came into being. Assynt is that part of the county of Sutherland which stretches from its western boundary with Ross-shire to the massive indentation formed by the sea loch system of Carn Bàn, Glen Dubh and Glen Coul. It came into the possession of the House of Sutherland as a result of it having been bought by Lady Strathnaver at a judicial roup in July 1757, after the sequestration of Kenneth Mackenzie of Seaforth. I am sure that none of you need to be reminded of the part played by our subsequent Duke in the eviction of about 15,000 of the peasant people of Sutherland between 1811 and 1823, to make way for sheep.

A century later, in 1913, as a result of financial difficulty, the then Duke offered for sale the whole of Assynt and Eddrachillis. The successful bidder was William Stewart who bought his native territory. He had left Assynt some years previously, the penniless son of a destitute crofter from the village of Nedd and had made a fortune in Canada as a railroad engineer. The outbreak of the Great War however largely frustrated the philanthropic intentions of Stewart towards his own people. In 1935 the estate was again sold, and on this occasion there were two bidders – the Vestey family and the Duke of

Westminster who wanted Assynt as a wedding gift for his son-in-law, Mr Filmer-Sankey. Westminster was the victor but soon after the title passed into the hands of Filmer-Sankey, he sold most of Assynt to the Vesteys. In 1989, Edmund H Vestey renamed the coastal crofting strip comprising thirteen townships and a total area of 21,300 acres (9,000 hectares) as North Lochinver Estate and sold it for £1,000,080 to a Swedish land speculator.

In none of these transactions were the interests of the people who lived and worked on the land thought to be relevant. Three short years later, Scandinavian Property Services were in liquidation, and the estate was again offered for sale – this time in seven lots. The Assynt branch of the Scottish Crofters' Union took action to address this crisis, initially in seeking to resist the further fragmentation of the estate by recourse to crofting law, but finally by mounting a press campaign and a public appeal to raise the funds to buy the estate ourselves. At our third attempt, a deal was done with the liquidator to purchase all of the assets of the estate for the sum of £300,000, and we took title to the land on 1 February 1993. Today the estate is in the possession of the crofters, free of debt and administered by a board of directors, democratically elected by each of the townships. Membership of the Trust is open to tenants and sub tenants of crofts, together with owner occupiers with shares in common grazing.

Assynt Hydro Limited

During the middle of 1992, while our campaign was at its height, telephone contact was made with me by one of the partners in a company of consulting civil engineers, who asked if I were aware that there was a potential for generation of hydro electricity on the estate. We discussed the matter in some detail but agreed that it was best if further discussion were deferred until the outcome of our campaign were known. In the spring of 1993, I renewed contact with the consultant to explore the matter further. It was clear to me at a very early stage that if the Trust were to make any lasting impact in the long term upon the lives of our members, then we would have to find ways of creating a cashflow which had hitherto not been considered in the running of the estate. In other words, if we were to rise from the situation of forever being dependent upon volunteer labour to run the estate, we had to find some core business activity which had the prospect of generating a fairly substantial cash income. My discussion with the engineering consultant seemed to suggest that a grid connected hydro electric power station was a good prospect for this.

Application was made in the middle of 1993, both to Caithness and Sutherland Enterprise and to ETSU for grant assistance to carry out a feasibility study into hydro generation. CASE responded quickly and positively. ETSU kept me dangling for a year before dropping me, by which time the study was underway anyway. While the study was in its infancy, the then Secretary of State for Scotland, Mr Ian Lang, announced the introduction of SRO 1, committing the Government to sourcing a percentage of our energy needs to renewables. The feasibility study was quickly transformed into a submission process under SRO 1. Approximately 190 bodies expressed an interest in bidding. In due course, around 40 contracts were awarded in various bands of renewable energy and Assynt Crofters' Trust succeeded in winning one of these for a proposal to generate 225 kilowatts, by raising the level of Loch Poll by 2 metres and releasing water down through a pipeline to a turbine at low level. A contract dated December 1995 was signed between ourselves, Scottish Power and Hydro Electric, committing each of them to take a percentage of our output of power, amounting in aggregate to the total. Detailed design work began on the project and application for planning consent began to be put in motion. It was from this point that our real difficulties began.

Unknown to me, a pair of black throated divers nest annually on Loch Poll, and our proposal to raise the level of this loch by 2 metres caused an instant reaction on the part of Scottish Natural heritage. In the light of discussion with their area scientific officer, it became evident that they felt obliged to object under the provisions of the EC Bird Habitat Directive to any development likely to affect the wellbeing of a bird appearing on Schedule 1 of the Wildlife and Countryside Act 1981. The normal course is for a developer to submit a planning application to the local authority who are bound to consult with a number of statutory bodies of which SNH is one. In the light of the circumstances, it was clear that planning consent would be refused, and the next logical step in the process would be an appeal to the Secretary of State, with all the cost implications of that. This was something that the Trust could never contemplate.

My approach was to attempt in discussion with SNH to try to find some compromise which would enable us to meet our aspirations, while at the same time safeguarding the interests of the birds. There was no willingness on the part of SNH to engage in meaningful dialogue: the interests of the bird was paramount and any unnatural variation in loch levels would not be countenanced. As I began to explore the situation, a number of interesting facts began to emerge. The entire UK population of black throats is found in Scotland, amounting to an estimated 150-200 pairs. Of these, 4% inhabit a group of lochs in Assynt, including Loch Poll. The pair on Loch Poll have failed to successfully rear a chick since 1984.

I began a process of trying to find a technical solution to our problem, while at the same time bringing public and political pressure to bear on SNH. This culminated with a lengthy letter to the editor of the West Highland Free Press in April 1997 which literally caused a storm. An

emergency meeting of the north board of SNH was immediately convened and steps were taken to undermine the credibility of my letter. Interestingly a comment by Mr Brian Wilson, MP (then in Opposition) was carried in the Herald, in which he came out strongly in support of my position. The date of publication of my letter was no accident; it preceded by a few weeks the forthcoming General Election and was deliberately timed to have maximum impact. In the months that followed the election of a Labour Government, I continued to harry SNH and the Scottish Executive but without much evidence of a change of position.

Time was passing and given the fact that our SRO 1 contract stipulated that we had to deliver energy into the grid within five years, I was becoming rather agitated to say the least. In autumn of 1998, in a desperate bid to get the matter resolved, I wrote to Lord Sewel, then Minister of State at the Scottish Office with responsibility for Rural Affairs and the Environment. No reply. Finally, I wrote to Brian Wilson at Dover House, with a copy to our own MP, Robert Maclennan. In this letter, I used some of the phraseology used by Brian Wilson in the report a year earlier in the Herald, and that did the trick. A fortnight later, I had a request from the Rural Affairs Department to meet with the Minister who concluded our discussion with a commitment of help. In October of that year, a meeting was convened in the offices of Highland Council Planning Department attended by all of the parties. On 27 January last year, planning consent was granted, with the unanimous approval of the committee. Work on site began in July of last year, and was effectively completed last week (July 2000).

To deal with our problems with the divers, I suggested to our consulting civil engineers that we consider raising the level of three of the upper lochs in the system, and in the event this proved to be feasible. We now have a scheme in which the main storage elements are represented by these three upper lochs, each of which has a small dam with a valved outlet. Loch Poll itself has been fitted with what we are calling a tilting gate structure which is controlled by a hydraulic ram, and can be adjusted to accurately maintain the water levels to keep the birds happy during the nesting season. The water intake is at the tilting gate, and is fitted with a penstock valve, to control the water being admitted to the pipeline. The 700 mm pipe itself is about 670 metres long and is buried over its entire length. A small generator building has been built at the end of the pipeline to house the turbine, the alternator, control gear, transformer and the Hydro Board metering and switchgear. Water finally discharges into a tailrace channel from whence it emerges into the original watercourse. Original estimates for construction of the facility were of the order of £465,000 within which a budget of £18,000 was allowed for pre planning costs. In the event, we are now anticipating an increase in the total contract value of approximately £100,000, of which some £70,000 is represented by pre planning costs.

The most demanding problems that we have faced were environmental concerns which could be classified under the headings of divers, mussels, landscape and fish. The work necessary to address these problems and the costs of professional environmental consultants escalated to such a degree that we have had to radically restructure the project. A cheaper, but less efficient, turbine has had to be purchased from the Czech Republic, and this will have the effect of diminishing our return. Nonetheless, we have a very well engineered project which, after the borrowings have been cleared, will produce a substantial annual income for the Trust, almost in perpetuity. On the basis of present calculations, I expect a weekly income of around £1,000.

As time progressed during the period which I have just described to you, it became increasingly evident to me that I could never complete the project on my own, and I sought out a commercial partner. In the event, I was introduced to David Mackenzie of Highland Light and Power Ltd, a Dundee based company with an already established track record in small scale hydro generation. A partnership has been established with this company for the duration of the fifteen year SRO 1 contract. They have contributed a financial investment, as have we, and they have brought with them a level of financial expertise and access to environmental consultancy of an extremely high order. I expect that over the fifteen year period of the contract that each of us will have an income of around £140,000, but at the end of that period, ownership of the total asset will be vested in Assynt Crofters' Trust. It is expected that the life of the M & E equipment will be of the order of fifty years, so we can expect there to be a substantial future income for the Trust to invest in other job creating ventures.

Chairman, I think it's safe to say that it was a much easier task to raise the funds and generate the enthusiasm to purchase the estate than it has been to bring this project to a successful conclusion. It has at times been a lonely and depressing struggle, but to now see the completed project brings a sense of great satisfaction. I hope that our successors who will largely reap the rewards of our efforts will use it to bring their own vision for future generations to fruition. Renewable energy offers one of the few opportunities available to our communities for sustainable development, and I hope that some of you here will seriously consider the prospect.

John Mackenzie

Energy Efficiency and Sustainable Housing

Ralph Throp is a Planning Officer with Scottish Homes in Inverness. His job is to build links between housing and sustainable development. An important consideration for him is energy efficiency.

Dùthchas is about sustainability – economic, social and environmental. Housing uses large amounts of energy and resources in construction and use. It is a fixed asset with a long life, and it is central to people's quality of life. Good quality housing can contribute to sustainable communities by:

- Creating local employment and training through construction and local services
- Providing accommodation for workers
- Allowing people to remain in their communities and attracting new residents
- Providing homes for a balanced community
- Reducing environmental impact through energy use and pollution

Poor design and inefficient heating leads to fuel poverty and environmental pollution. Fuel poverty in Scotland is very high because of low incomes and poor energy efficiency. The mean figure for the National Home Energy Rating in Scotland is 4.1 (which is low by UK standards), while in the Highlands and Islands that figure is down to 3.4. In the Highlands and Islands, 93% of dwellings do not reach the standard that new publicly funded homes have to attain (that figure now being 7).

Benefits of Good Design and Construction Quality

Did you know:

- The use of trees and planting can save up to 5% on energy bills (maybe not in Trotternish)
- The use of sunshine collected in dwellings can save up to 15% on energy bills
- Professional painters have a lung cancer rate 40% higher than average due to exposure to toxic solvents and other chemicals in the materials they use
- PVC is restricted in use in several European countries due to its potentially harmful environmental effects
- The use of additional insulation in housing can achieve substantial energy savings for very little extra cost
- There are a variety of alternatives to toxic timber treatments including no treatment at all
- There may be over 250 different chemicals emitting fumes in a typical new kitchen.

Scottish Homes Sustainable Development Policy

Until the late 1990s, housing standards were based on space standards. In 1998, Scottish Homes introduced Housing for Varying Needs which requires housing design to be barrier free, and to take account of the needs of

elderly and disabled people etc. In 2000, 2 new design tools will be introduced. The first of those is the Sustainable Housing Design Guide which is user friendly with practical design guidance. It informs on how to incorporate sustainability into design, maintenance and rehab of housing. It includes case studies for good practice. The second is the Housing Quality Assessment Programme which is a user friendly software programme to be used by Housing Associations and Scottish Homes to assess the extent to which quality housing has been delivered.

Scottish Homes Grant Mechanisms

There is a need to move from the concept of upfront costs for housing to "whole life costs". Higher construction benchmarks equal lower maintenance costs in the long term. The likely options are:

A Housing Association grant – A grant for a housing association to build homes for low cost rent – approx 70%
A Rural Home Ownership grant – A grant for a household to build or renovate a home for purchase – up to 33%
A Rural Empty Property Grant – A grant for an individual to renovate an empty home for social rented market

An Energy Efficient House for Trotternish – What could it look like?

Previous experience (Orkney) has taught that the best solutions are low-tech, quality measures including:

1 Ventilation – high grade sealing; solid floors; whole house ventilation systems or passive stack ventilation
2 Passive solar gain – layout; window sizes; solid flooring
3 Heating – gas or oil fired; shared boiler (1 for up to 4 houses)
4 Enhanced insulation – carries risks and benefits
5 Dwelling form – terrace or courtyard (more is less)

In conclusion, the Next Steps are to address the following:

- Whether there is support for the idea of an Energy Efficient Housing project in Trotternish, and if so …
- Whether the perceived demand is for rented housing or homes to buy?
- Whether it is possible to build a group of houses together?
- Whether we want a new construction, renovation, or a mixture?
- Whether developable land is available?
- And we need to involve the community, Lochalsh and Skye HA and Scottish Homes

Ralph Throp

Wave Energy

David Langston is the Business Development Manager of Wavegen in Inverness. They began the work of fund raising and investment into wave generation 10 years ago. Wave energy is quite distinct from hydro power. Today this company's wave project in the Isle of Islay is the first commercial scale wave project in the world.

The Company's Background

- Founded by Professor Alan Wells FRS
- Raised and invested over £8 m for technical development
- World leading patented technology
- Long term research collaboration
- EU and UK Government support
- Export sales
- 500 kW SRO shore line plant under construction
- Built 3 MW of plant
- Sustained power cost improvements
- 2 MW offshore device to be constructed in 2001

Facilities

Offices and wave tank test facility

The Team

Alan Ace (Chair), Ferdinand Elsener (non-exec Director), Allan Thomson (MD)
David Gibb (Finance Director), Dr Nick Wells (non-exec Director), Dr Tom Heath (Engineering Manager), David Langston (Business development), Administration

Engineering team (numerical modelling; hydrodynamics; aerodynamics; mechanical; electrical; marine)

Renewables

Renewables Market

- Growing demand for energy
- Greenhouse gases (Kyoto Protocol; Shift from carbon based energy)
- Growing renewables market – eg wind annual growth 15-34% in the 90s
- Potential for significant future growth (Renewable sources are expected to provide between 5% and 10% of the world's energy within 25 years, perhaps rising to 50% by 2050 – Shell)

The UK Situation

- Utilities Bill
- Obligation on Electricity Suppliers
- Target 5% by 2003 and 10% by 2010
- New and Renewable Energy – Conclusions
- Exemption from the Climate Change Levy
- Green Trading/Green Certificates

Types of Renewable Energy

- Photo-voltaic
- Solar heating
- Biomass
- Energy from Waste
- Hydro
- Wind
- Offshore wind
- Tidal stream
- Wave

Wave Power

"It has been estimated that if less than 0.1% of the renewable energy available within the oceans could be converted to electricity it would satisfy the present world demand for energy more than 5 times over."

Wave Power

- No fuel
- Low noise
- Low visibility market
- Large potential
- Scotland has technical lead HIE area
- Major resource in the
- Replacement for "Offshore" jobs
- Chance for Scotland to repeat the success of the Danish Wind Industry

Wave power markets

- Island power. Grid connected power. Water. Offshore

The Technology

Applications

- Coastal protection/harbours
- Desalination
- Offshore power
- Aquaculture
- Navaids

Summary

- Growth industry
- Scotland leads the way
- Potential major Highland export industry
- Synergy with Offshore Wind
- Aquaculture development
- Desalination and irrigation opportunities
- Accessing major European energy resource
- Sustainable jobs in a long term growth sector
- Revitalising offshore construction and support industry

Project Elements are listed below.

- Ducting
- Rotor and bearings
- Generator bed
- Generators
- Controls
- Control panel
- Valves
- Assembly
- Site construction
- Grid connection
- Structural Design
- Electrical consultants
- Wave resource assessment
- Bathymetric surveys
- Project development
- Representatives
- Project finance
- Environmental impact assessment
- Installation
- Commissioning
- O & M

David Langston

Building Design

David Dittman is based at Ecotech Homes near Findhorn.

Traditional buildings the world over have been constructed of local material, and building was essentially a sustainable craft. Former villages across Scotland were built of earth, wood and stone, and few traces now remain where these settlements have been abandoned. They have returned to the earth, completing the cycle.

Since these days we have "progressed" through an era of trade and industry that, despite its benefits, has transformed a locally based craft into an international business with a colossal impact on the environment. New expectations and challenges may preclude a return to the old ways, but the principles of living within our means need to be rediscovered.

To reverse global warming, it is now accepted that we have to cut our reliance on fossil fuels, and that building regulations advance more stringent insulation standards. However, this alone does not create sustainable and healthy buildings, and other issues need to be considered.

Before addressing these, it is useful to further consider the use of energy for heating, and study what reductions can be achieved. Space heating can be generated by passive gains from the sun and activities within the house, and there are examples in Scotland of houses so well insulated that they require virtually no additional heat input. Typically, this is achieved in a well planned design incorporating 30 cm of wall insulation, 40 cm of roof insulation and high performance doors and windows. Water can be heated with the assistance of solar panels, and it is possible to generate electricity by wind power or photo voltaic panels. However, these latter options are costly, and it should be remembered that it is usually cheaper to save energy than to generate it.

Inevitably, the change to highly insulated and draught proof housing creates problems within the internal environment. With air changes as low as half an air change per hour, pollutants are not dispersed adequately, and their concentration can increase to troublesome levels. Whilst the building industry largely disregards the problem, there is growing awareness and it seems sensible to specify materials and appliances that do not emit toxins. From reconstituted boards – eg chipboard – to paints and carpets, safer options are available.

Embodied Energy also needs to be considered. It takes a considerable amount of energy to build a house, and the manufacture of certain materials is highly polluting. For example, concrete – an essential part of modern construction – is thought to contribute 10% to global CO2 emissions. In building ecologically, the embodied energy of material manufacture, transport and installation is taken into account. It may not always be appropriate to select the material with the very low embodied energy,

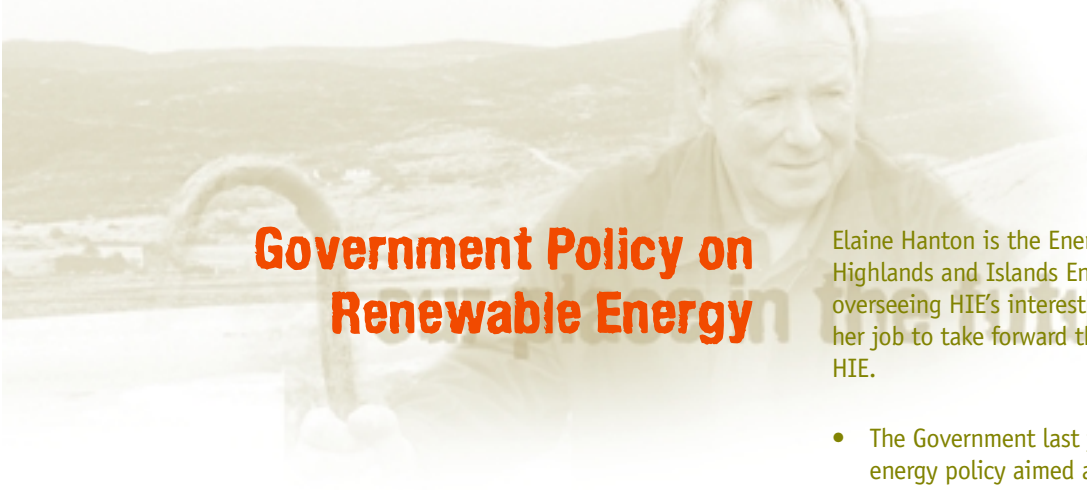
but it should be part of the design debate.

Key facts:
Important points relating to eco housing examples from Findhorn are given below.

1 A 75 kilowatt community generator erected in 1989 achieved a pay back in five years, illustrating the economic benefits of a unit shared by a whole community or a number of households.
2 Waste water from the village of Findhorn is treated to a high standard by a Living Machine, a system using plants in a greenhouse environment.
3 Roads on sites are minimised and narrow, slowing vehicle speeds, creating a safer space - particularly for children - and opening up more land for gardens.

In conclusion, building ecologically can reduce our impact on the planet, but with thought and planning we can also create environments that improve our health and living standards.

David Dittman



Government Policy on Renewable Energy

Elaine Hanton is the Energy Projects Manager for Highlands and Islands Enterprise. She is responsible for overseeing HIE's interest in Renewable Energy. It is also her job to take forward the Renewable Energy strategy for HIE.

- The Government last year announced a new renewable energy policy aimed at the UK meeting 10% of electricity demand from renewable sources by 2010. Target is to be met through the introduction of a simple percentage obligation on all electricity suppliers. A cap on the price payable by electricity supply companies for renewable energy will be introduced to prevent too heavy a burden being passed to consumers.

- Scotland already meets the 10% target but Scottish Ministers have announced that they intend to set an additional 5 % target for Scotland. It is expected that this could be met from between 600-800MW of new onshore wind generation.

- The introduction of a price cap is likely to encourage the best established and hence cheapest technologies (ie wind) and discourage emerging technologies (ie wave; biomass). It is unclear how the Government intends to support emerging technologies. The Climate Change Levy, which will be introduced in April 2001, will be used to establish a fund to support renewable energy and energy efficiency. Details of how the fund will be used are not yet known.

- Major obstacles to development in the North include lack of support for emerging technologies which have good development potential in the Highlands and Islands, difficulty in obtaining planning permission and costs associated with connecting to the electricity grid.

- Lack of spare capacity on the grid is the single biggest obstacle to renewable development in the Highlands and Islands. Scottish and Southern Energy (SSE, formerly known as Scottish Hydro-Electric) own and operate the grid in the Highlands and Islands. New generators connecting to the grid are liable for local connection costs and the cost of any upgrade required to the grid as a result of that connection. These costs can be substantial.

Elaine Hanton

The Environment and the Landscape

Caroline Stanton is Landscape Adviser to Scottish Natural Heritage for the North Areas – from the Cairngorms to the Western Isles. She advises on development proposals in the north and raises environmental issues with regard to Renewable Energy.

1 It is important to stress that landscape is just one of many environmental issues regarding renewable energy. However, it is of particular relevance to the three Dúthchas areas as they all lie within National Scenic Areas (NSAs), reflecting the quality of the landscape resource. Information on other natural heritage concerns can be gained from SNH Area staff, the contacts for which are listed in the SNH leaflet "Who we are & where we are".

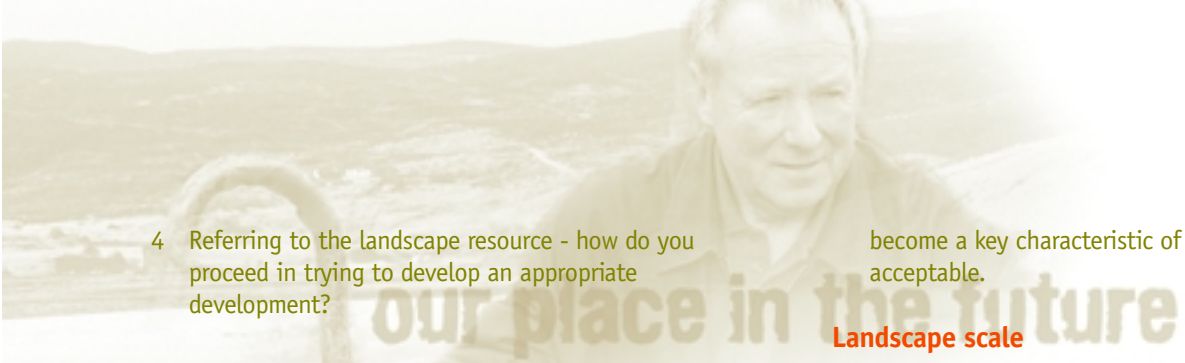
2 The aim of this presentation is to introduce some of the key landscape issues associated with generating renewable energy and, using slides, demonstrate the various implications of these for any development.

The Landscape Resource

1 So where do you start? The starting point as far as SNH is concerned is the landscape resource. SNH would encourage that a landscape is assessed as being suitable for a particular type of development rather than choosing a specific type of development and then trying to fit this to a landscape which may or may not be appropriate for its use.

2 SNH is generally very supportive of renewable energy developments as part of its commitment to sustainable development. So yes - SNH supports the claim made by the seminar title – "it can be done". But we would add a warning that it takes a lot of work and it is not particularly easy because it is incredibly important how it is done in relation to the sensitivities of a particular environment. It can be done – but like any form of development, it can be done well and it can be done poorly. Just because the concept of renewable energy is embraced by positive messages of being green and clean, this does not exempt developments from having environmental impacts in their own right – and for these to be positive, a great deal of care needs to be taken in order to relate any development to the particular characteristics and sensitivities of a specific landscape.

3 There is a great deal of difference between an appropriately or inappropriately sited and designed development. We may have those that look just right – fit for their purpose and place; but also those which only bring bad feeling – for both the technology type and the location. For any area which is valued by both residents and visitors for its quality of landscape, this is a fundamental concern.



4 Referring to the landscape resource - how do you proceed in trying to develop an appropriate development?

First, the existing characteristics of the landscape and how these are experienced and valued needs to be examined. At the strategic level, this is aided by existing guidance such as that contained in Landscape Character Assessments (LCAs). SNH has published a suite of these that cover the whole country which highlight the key landscape issues concerning development in different landscape character types.

The publication – "Scotland's Scenic Heritage" also gives a clear description of each NSA, indicating for what it is valued.

These sources of information provide a strategic guide. However, at the site specific level, an assessment of the landscape is still necessary to determine how the landscape character of a specific place would best accommodate a development. For example, its scale and sense of exposure, its pattern and key foci, and importantly how it tends to be experienced such as whether there is direct access or not or whether an element will appear as impinging upon the sense of wild land.

There are also many design options for a development. For example, for a windfarm, the number and size of wind turbines, the layout and spacing of these, the turbine design (blade number, tower type and shape, colour, transformer etc) and the use of associated facilities.

Essentially, there are always options and methodical assessment is the only way to fully understand what possibilities there are in meeting the aims of a development in order to create the most appropriate solution.

5. From a landscape assessment, we can, for example for a windfarm, determine the following aims:

Landscape distinctiveness

- whether the landscape is so unique and special so that the windfarm must only be seen as a minor feature within the landscape, rather than something which appears so dominant or extensive that it is seen to change the whole character of an area, particularly in NSAs where the integrity of the designation may be affected;
- Or, alternatively, a landscape which is fairly common and unremarkable, although obviously still of value, where the introduction of a new element which would become a key characteristic of the landscape would be acceptable.

Landscape scale

- whether the landscape is best suited to a large scale development either because of exposure or the scale of other features already present;
- or, alternatively, a small scale development;

Landform

- whether the landform, most obviously illustrated by the skyline, is consistent so that any development can create a simple image;
- or, whether the landform is quite complex and thus a development will have to be limited in extent if to avoid resulting in a confusing image;

Landscape pattern and function

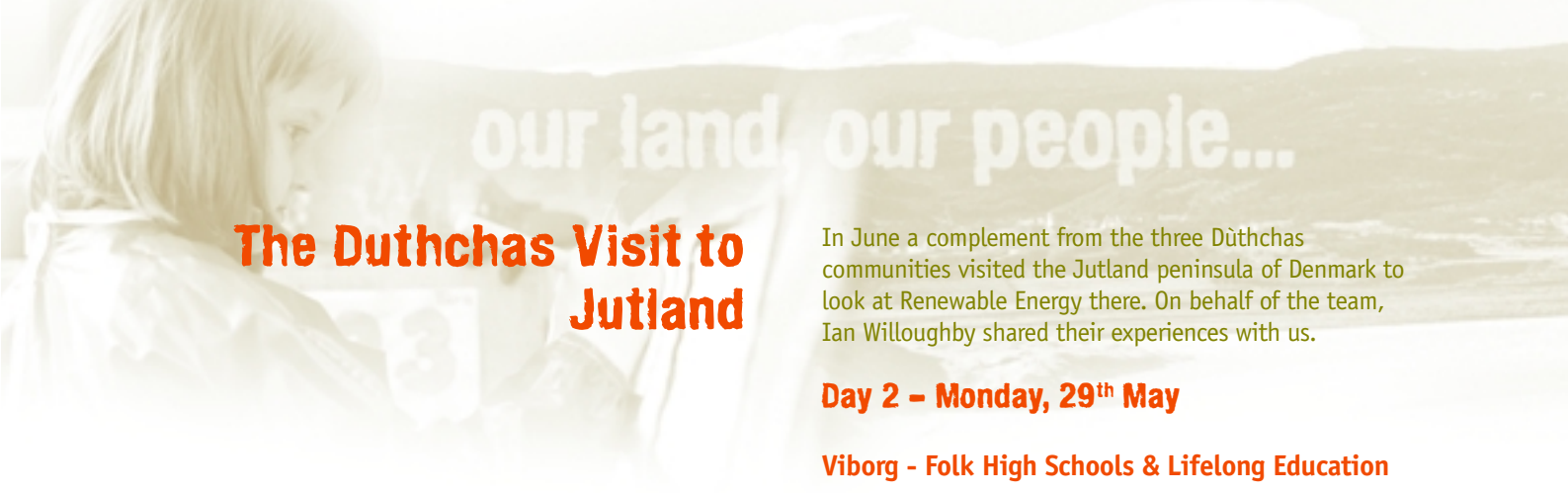
- whether the windfarm should appear to directly relate to a specific building, settlement or land use as an obvious landscape characteristic;
- or, whether it should be located distant from any existing built development to result in a more sculptural look and to seem less intimidating in places where people commonly reside or visit;

- And, whether the development is able to directly relate to existing infrastructure;
- or whether, it would be best if the development seemed as an isolated feature which is devoid of associated services which may imply a more utilitarian image and have considerable impact in its own right.

4. For any particular site, and any specific renewable energy technology, it is important to develop this type of list - proposing design aims in relation to the particular characteristics of a landscape. You will find that in some places there will obviously be competing interests that need to be reconciled or other forces which don't allow the ideal - for example land ownership or electricity grid.

5. It is important to stress that there is no standardised solution for the siting and design of a renewable energy development. Every scheme is different just like every landscape is different. And, whether the development is small or large in scale, community run or a commercial operation, a high level of care is necessary if there is to be a positive impact on the environment.

Caroline Stanton



The Duthchas Visit to Jutland

In June a complement from the three Dùthchas communities visited the Jutland peninsula of Denmark to look at Renewable Energy there. On behalf of the team, Ian Willoughby shared their experiences with us.

Day 2 – Monday, 29th May

Viborg - Folk High Schools & Lifelong Education

Lifelong learning is seamless and integrated with community action. Thus a capability is built, through membership of associations for Community Enterprise. For example, most of the local energy projects (such as the prevailing small groups of wind turbines) are community initiated, promoted, supported and used.

The certainty of obtaining planning permission is thus secured.

Viborg Folk High School has a special heating system. The school buys natural gas, burns it to produce heat for the entire school and at the same time generates enough electricity to power the entire school. Additionally, there is a surplus equal to 22% of the output which the school sells to the National Grid. Only in that latter part is the school taxed.

The Folk High School founded in 1950, with 150 students, is what we would call a college for 20-25 year old students, voluntary and fee paying. It is mainly concerned with IDRAD (folk gymnastics) ie, citizenship and ball playing.

Twenty years ago the students doubted the use of Nuclear Power as alternative energy, so they plumbed for Wind Power. The original one has been running for 20 years.

Key Facts

- Natural gas for heating is taxed.
- Natural gas for making electricity is not taxed.

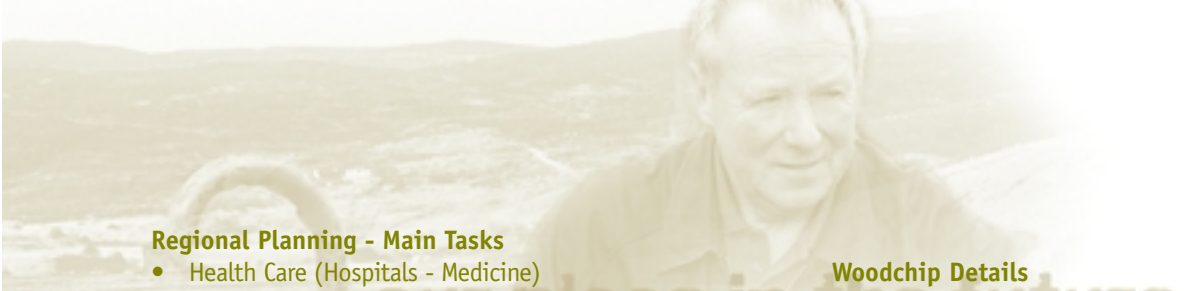
They are taxed for using electricity but not if you make it yourself. By 2030 35% of electricity will be from Renewable Energy! Folk High School Renewable Energy - 100,000 hours of run and very convincing.

Day 3 – Tuesday, 30th May

Viborg - Regional Planning: Danish Regional Authority

Key Facts

- Political Governed
- Mainly Tax financed £400 million
- 6,500 employees in Viborg



Regional Planning - Main Tasks
- Health Care (Hospitals - Medicine)
- Education (High School for Adults)
- Social (Special Institutions)
- Roads, Environmental & Planning (approx 3.3% turnover)
- Permissions from community (Department of Planning)

Unemployment
- 4% unemployment in Denmark
- 3.3% unemployment in Viborg County

Population
- 23 million pigs
- 5 million people

Renewable Energy Use, Resources & Environmental Impacts
- 5,000 windmills giving 10%-20% of energy for Denmark: some parts 100% energy for district
- 4 years to pay the windmill then clear money, and they last for 25 years
- Drinking water not from rivers only from ground wells 20-40 m deep
- Phosphorous in cities down to almost zero
- Nitrogen in agriculture down by 30%
- With fertilisers and draining, soil levels go down and flooding takes over

Viborg- Energy and Environment Office

Key Facts
- Offices are set up to give free information on grants and savings towards setting up your own biomass, bioenergy, etc
- Government Subsidy for Solar Heating = 20% of Cost!
- Windmills on the landscape

Skive - Solar Heating Large Public Schools

Key Facts
- Heating for rooms and hot water supply
- 24W DC/ 24 volts

Kjellerup - Woodchip District Heating

Key Facts
- Produces 97% of heat in town, a few buy oil or gas
- 1957 - first Fuel Oil
- 1986 - choice - Natural Gas or Woodchip? - Voted for Woodchip

Woodchip Details
- 8 containers per day - price 150 Kr/load
- 2 400 cubic m - water content high
- Loads within 45 Km area
- Pollution is less
- Totally automatic
- Efficiency is 115% !
- Price for plant is 16 million Kr.
- Price for Natural Gas Plant is 4 to 5 million Kr.
- Temperature - 75° out; 35° return

Tandskov - Landfill Gas, High Technology Power Production

Key Facts
- 30 acres established 1997
- 54 openings in the ground
- From 1985 to present, 250 cubic metres/hour
- About 50% efficient
- 550 KW/hr
- 5 years payback
- 20 Kr/Trailer
- Waste moved 6 to 8 times and is separated
- 8 to 9 months to complete process
- 80% for sale (ie compost)
- 20% for covering the Biogas area and for new areas

Day 4 – Wednesday, 31st May

Viborg - Vestas Wind Energy, Assembly of Turbines

Key Facts
- 150 kW Turbine
- Alternative energy (political issue)
- Philosophy is to have as much know-how as possible
- 6 Engineers working for future
- Fast investment for your money

Wind Tower Details
- Tower height up to 55 m (180 feet)
- Rotor diameter 39, 42, 44, 47 m (154 feet)
- 660 kW

Hodsager - Biogas and Woodchip Heating of Entire Village

Key Facts
- Supplies 150 houses
- Slurry producing gas
- Nitrates for plants
- Back-up system - woodchip - oil - biogas-burner
- Capacity 40-45 cubic metres biogas per day
- Plus Woodchip burning facility from forests around Hodsager

Hurup - Folkecentre for Renewable Energy

Key Facts: Housing
- Underground House seats 200 people
- Low energy
- Electronic curtains
- Straw Home
- Muscle shells under concrete for drainage
- Building blocks made of clay, chalk, and straw
- Waste Water Treatment Plant (dyke pond system)

Key Facts: Energy House
- Produces more energy than it uses per year!
- Has mobile polystyrene pellets
- Fish nutrition from Biogas
- Digested animal manure

Key Facts: Oil Seed Rape for diesel car
- Starts with diesel - then oil from rape introduced
- Car runs for 90,000 km - 5 years and no problem!
- Gas for fuel
- Gas for furnaces to produce electricity

Key Facts: Electricity from wind power
- Producing hydrogen and oxygen from water
- Hydrogen back to electricity through generator
- Cars on electricity generated by windmills

Key Facts: Wind Turbines
- 10 to 12 small scale windmills suitable for individual houses, being tested daily, they produce all the electricity required for the entire centre
- In this area 180 privately owned wind turbines producing approximately 70 million kW hrs equal to consumption of 17,000 houses!

Day 5 – Thursday, 1st June

Knudby - Photovoltaic for 39 local houses

Key Facts
- 43 people owning and sharing one Wind turbine
- Solar cells for lighting
- 3,800 kW per year
- 3,400 w per hour
- DC to AC converter

Laastrup - Large Pig Farm (intensive)

Key Facts: Biogas
- Pigs manure to Energy
- Produces more energy than you need together with Heat
- Methane contains carbon dioxide and nitrogen
- 1 cow gives 7 kW per day
- They have 4,500 pigs in this farm including 500 sows, all in substantial buildings out of the elements
- Slurry from stable to reactor then heated
- 1 cubic metre of manure = 22 cubic metres of gas

Day 6: Friday, 2nd June

Studsgard - Biogas (Stirling Motor) Plant

Key Facts: Biogas
- Waste plant (slurry etc) piped from farms and back to farms as compost (60% from pigs and rest from cows) + food processing industry (slaughterhouses, organic waste from homes).
- One tank for household waste, one for slurry etc
- Imported vegetable oil from Europe is treated here
- Environmental benefit (slurry is recycled)
- Manure is free from sickness and poisons etc so goes back on to land
- Trucks are cleaned so no cross-contamination
- Most pigs are intensive (some are free)

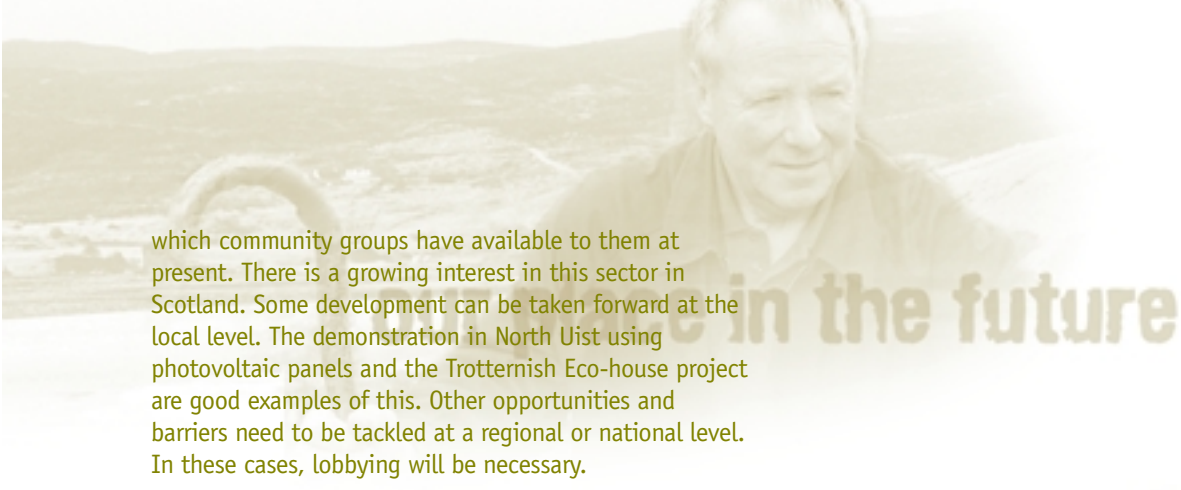
Key Facts: Feed the Process
- Temperature 52° - kills disease from slurry and kills BSE (15 days to ferment) (prions)
- Denmark does not have BSE
- 70° would not destroy prions
- The plant is computerised
- 60 cubic m gas/day - much more than other plants because of extra wastes used
- KFK Herning compresses gas (contains sulphur)
- Wash gas with slurry to remove S and produce S2, which is taken out and goes to farms in compost

Kolding - Photovoltaic for large blocks of flats and bioplant water recycling

Key Facts: Bioplant Water Recycling
- Surface water used for washing and toilets etc
- Inside Glass Pyramid they have fish and plants
- Water collected and aerated
- 140 flats connected to the system (250 people)
- The people do not pay for water if they take care of their dirty water (ie reduce use of bleach etc)

Conclusions

The Dùthchas communities are rich in renewable resources. This Study Tour has illustrated the diverse possibilities available through renewable technologies. This opportunity has taught us much about these technologies. The way in which production and consumption of power, heat, water and light is currently organised at home has a strong influence on the choices



which community groups have available to them at present. There is a growing interest in this sector in Scotland. Some development can be taken forward at the local level. The demonstration in North Uist using photovoltaic panels and the Trotternish Eco-house project are good examples of this. Other opportunities and barriers need to be tackled at a regional or national level. In these cases, lobbying will be necessary.

(Please see the Jutland Study Tour Report for further information.)

Biomass Energy – Warmth from Wood

(part of Torren Energy Limited)

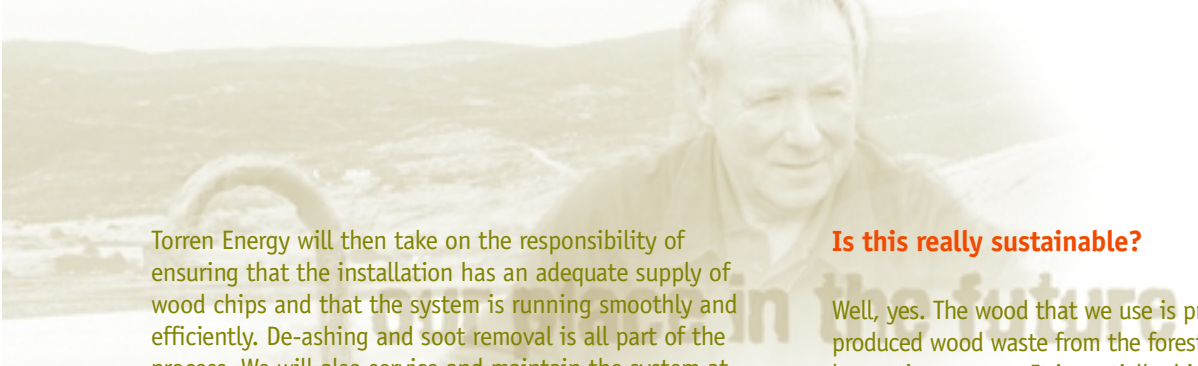
Victoria Sutherland represented her son, Andrew Sutherland, at the seminar. Renewable energy is not a new topic for Victoria since she is Danish, and she has been involved with Torren heating from its beginnings. Biomass is brand new in Scotland. And Skye has been chosen as the location for the first biomass plant in Scotland.

We aim to be the first fully commercial wood fuel energy management company in Scotland.

We liken ourselves to a utility company. We do not sell wood chip heating systems. What we sell is heat. We have a range of different operating methods for different sized customers and these are generally broken down into commercial customers, domestic customers and district heating.

We will be concentrating initially on the commercial customers. A typical commercial customer would have a large space-heating requirement. Our system is particularly appropriate for hotels, hospitals, council buildings, residential care homes, swimming-pools or recreational facilities. The system could also be used for supplying heat or pre-warmed water for industrial processes like distilling and brewing. In fact any premises with a sufficient heat load is suitable.

So how do we supply this heat? We will be directly approaching those commercial customers whom we think could benefit, and assessing their existing cost of producing heating water and domestic hot water from their current fuel – be it oil, gas or electricity – by measuring the efficiency of their existing boiler. We will then assess the cost of removing this boiler and replacing it – at Torren Energy's expense which will include installation, equipment and everything - with an automatic gravity fed from an integral hopper, wood chip boiler connected to their existing pipe-work. If, after assessing these costs, Torren Energy feels that it has a competitive edge over the existing fuel, we will then quote the customer for the supply of heat virtually entirely generated from burning wood chips. We have the advantage here in that we can guarantee the cost of the heat up to five years in advance – surely attractive in these days of fluctuating fuel prices. The heat that Torren Energy produces from this equipment will be metered with a heat meter and therefore only the number of kilowatt hours (ie amount of hot water) actually used will be paid for. The boilers that we use are dual fired in order to allow a source of backup, the other fuel generally being from the customer's previous fuel source. In reality, the only situation that we have come across to date where we cannot be competitive is with natural gas. Hence this concept is perfect for rural communities.



Torren Energy will then take on the responsibility of ensuring that the installation has an adequate supply of wood chips and that the system is running smoothly and efficiently. De-ashing and soot removal is all part of the process. We will also service and maintain the system at no cost to the customer. As we will only be billing you for the hot water actually generated and used, it is in our interest to make sure that the boiler is running as efficiently as possible at all times!

We do not want the customer to have to worry any more about how the wood chip boiler is producing their heat than they would worry about an oil or gas-fired boiler.

What about the emissions? True the system will produce a whiff of wood smoke, but considerably less than you would imagine. In order to reduce this to zero, we are researching special condensing flues, which not only will remove the smoke particles from the flue gas, but will also increase the efficiency of the boilers to in excess of 90%.

Torren Energy will be driven by the commercial customer. Once the infrastructure is in place to provide fuel, then domestic customers can also take advantage of lower heating costs using locally produced wood chips. The systems and installation for the domestic customer will be charged for, but at cost price, and if an old boiler is being replaced anyway, we would like people to be able to think of wood chips as a real and competitively priced alternative to Oil or Gas.

The last customer type is groups of houses. The concept of district heating is not new even in this country. This will work well in towns or villages where the dwellings are not too scattered and the land is flat. If there is a sufficient concentration of houses, hot water can be piped into people's homes and once again, metered. A suitably located boiler fired by wood would generate the heat. This concept is one that Torren Energy, together with Lochaber Enterprise, is working on to produce heat for a housing scheme in Kinlochleven. There are also a number of suitable sites in Skye and Lochalsh which Torren Energy is already looking at – including Achmore in Lochalsh and potentially even Kyleakin.

The boilers that we use for all the different customer types come in all different sizes and are manufactured in Finland. The company that produces them sells thousands of units every year in Finland alone. This is not new technology: in fact these systems are the norm not the exception. The controls and heat meters are all manufactured in Denmark. In countries where there are no natural fossil fuels, these sorts of systems have been a necessity.

Is this really sustainable?

Well, yes. The wood that we use is predominantly locally produced wood waste from the forestry extraction and harvesting process. It is partially dried on site and then moved to drying sheds in order to be turned into wood chips and dried further. Once the chips are sufficiently dry, they can be used as a fuel. We will also be using low grade timber – normally destined for the production of chip board, but in the current environment is losing local timber producers considerable amounts of money. And lastly from saw mill residues. We have applied for accreditation from the Forestry Standards Council which will mean that all our wood fuel has come from sustainably managed forests.

If demand becomes so high within any given area that Torren Energy operates in, and there is insufficient supply of wood on a sustainable basis, then there is always the possibility of entering into an arrangement with local farmers to supply us with wood from Short Rotation Coppice. Last year Andrew had a meeting with the local crofters around Broadford to air this option.

For the first time, the managers of large premises, government and private, now have the choice to supplant their fossil fuel usage with a locally grown renewable fuel – at no extra cost to them and with the added bonus of sustainably lower heating bills.

Victoria Sutherland

Wind Power and Solar

Ingenco was formerly Scottish Power Technology – the engineering consultancy arm of ScottishPower. Ingenco has worked on a number of wind farm projects throughout Scotland, Ireland and England. Ingenco designed and implemented a small scale wind diesel scheme on the Island of Muck, in the Inner Hebrides. Ian Irvine is the Senior Renewable Energy Consultant at Ingenco.

Background to the Muck wind diesel Scheme

- Original scheme was started in 1992 with EC funding
- Contractor went bankrupt in 1994
- Ingenco (SP Technology) became involved in 1995
- 1997 Application for EU funding to complete the project was unsuccessful
- Lottery, LEC & Local Authority funding became available March 1998
- Ingenco awarded Turnkey contract for design, procurement, installation and commissioning April 1998

The Island of Muck

The island of Muck is nominally 3km by 4km. The population is around 38, with the majority of islanders living in the population centres of Port Mor in the South and Gallanach in the North. There are 18 households on Muck which has a primary school and a telephone exchange. The main access to the island is by ferry or landing craft, up the narrow channel and bay to Port Mor. The tidal range here posed many logistical difficulties.

The wind turbines are located just above Port Mor on Carn dearg, at a 30 m elevation. Monitoring the resource is the means by which you can determine your energy yield so that you can go to the bank to borrow money. Monitoring will also help you to determine what type of machine will be appropriate. Monitoring includes:

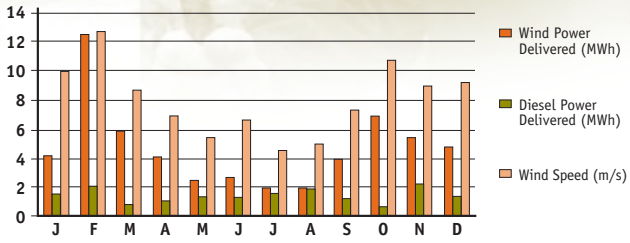
- Anemometer calibration and installation
- Direction vane setting
- Mast location relative to topography
- Mast co-ordinates
- Mast maintenance
- Data collection, screening and archiving

The chart illustrated below shows the monthly power production for the year ending 31 December 2000. The black bars show the electricity delivered to the grid - that is the gross wind power delivered minus power converter and transmission losses between the turbines and main distribution board 300 m distant. The corresponding average wind speed for each month is shown by the red bars. As would be expected, power production is greatest during the winter months with the highest wind speeds, falling to a minimum during the summer. This is rather convenient, as this trend follows the annual heating demand, enabling maximum penetration of wind energy.

Diesel power generation - shown in yellow - is least during the high wind speed winter months. Indeed, the diesel generator was not used at all during a 5 week period spanning January and February. The demand for diesel is,

as would be expected, greatest during the summer months when the wind speed is more intermittent.

System Energy Yield for the Island of Muck in 2000



Energy Yield Summary

Data for One year - January 2000 to January 2001

- IoMPC operated the wind/diesel system with technical support from Ingenco
- Average wind speed - 8metres per second
- Total Power Delivered - 71 Mega Watts per hour (78% Wind: 22% Diesel)
- Potential wind power delivery -97 Mega Watts per hour (27% Shortfall)
- 2631 kilo Watts per h per person gross, compared to 3842 kilo Watts per hour per person
- Nominal Tariff – 10 pence per kilo Watt per hour (compared to 9 pence per kilo Watt per hour on UK mainland)

The Isle of Muck Power Company has operated the scheme with technical support from Ingenco since January 2000.

During this year the average wind speed at the site was 8m/s. 71MWh of electricity was delivered to the network, and this comprised of 78% wind and 22% Diesel. The predicted wind power delivery for this wind speed was 91MWh. The difference between predicted and actual can be accounted for by a poorer turbine performance than expected - a lower than average annual wind speed and lower demand than expected.

Compared to actual data from Fair Isle, the 2631kW/h per person figure is close to the lower figure in the range. It is expected that this will increase with time. A significant reduction in diesel fuel has been observed, as the island consumption.

It is worth noting that the nominal cost of power has reduced from around 26p/kWh to around 10p/kWh which compares favourably to domestic mainland prices.

Community Survey

A questionnaire was prepared by Ingenco and issued to all the households on Muck. 17 of the 18 households on the island returned the questionnaires, and this was a good response. The survey results represent effectively a report card on the wind diesel scheme. Zero per cent on the results corresponds to a very poor performance on the questionnaire. One hundred per cent on the results corresponds to very good. Our performance and the performance of the scheme could be summarised as "could do better". Overall, the islanders consider the scheme to be better than what they lived with previously. The most negative aspect is the blackouts that occur while switching from wind power only to parallel diesel operation. If anyone can assist with a cheap autosyncronisation unit to remove this problem, Ingenco would be pleased to hear from you. On a positive note, two of the most contentious issues regarding wind turbines – ie noise and visual impact - were viewed favourably, with a score equating to good. Some key design features were also viewed favourably - namely the dual tariff facility and the Ingenco designed consumer units that indicate the grid status. We will continue to monitor the situation and use this feedback to improve the system.

Community Survey Results

Meeting expectations	56%
Value for money	50%
After sales support	46%
Project implementation	60%
Cost to consumer	60%
Benefit of storage heaters	66%
Blackouts during operation	37%
Dual tariff facility	73%
Ease of use of consumer units	74%
Comparison to previous system	74%
Wind turbine power production	54%
Noise emissions from turbines	64%
Visual impact of turbines	64%

Note when reading the Survey results above, 0% indicates a very poor performance for that aspect, while 100% indicates an excellent performance for that aspect)

Future Development

EU Framework 5 Funding obtained for Windplus Project

- Ingenco's Partners: Vergnet, ECN, RISO, CINAR, ALTHSTOM
- Objective: to improve wind diesel system performance and reduce capital costs
- Project started November 2000, and runs for 36 months
- Completed with demonstration project somewhere suitable in Scotland

The Capital Cost of a Wind Project
£700-£1,000/kW for large scale grid connected schemes
£1,100-£2,000/KW for small scale grid connected schemes
£6,000/kW for small scale stand alone schemes

Ian Irvine

Towards a Sustainable Skye

Alexandra Hayles is the Director of SERM - Safety & Environmental Risk Management Rating Agency. The Dùthchas team met Alexandra while they were out in Jutland, and they invited her to attend the Seminar. Alexandra aimed to focus on how we can use our resources to create more sustainable societies in rural Scotland.

Applying what we know
Adopting the broad perspective

Our Responsibility
- Responsibility to whom for what?
- How progressive should we be?
- Economic versus social or public responsibility
- Do these always conflict?
- How can you measure them?
- What do you do once you have made your choice?

Changing the social contract
- Who should exercise control?
- Is there a conflict of interests (business must appreciate profit maximisation involves sustainability)
- Using the environment to develop new industry

How did we get to the current crisis?
- Industrialisation
- Exploding demographics (thanks to better health care)
- Pursuit of short term (non sustainable) profit
- Lack of a broad perspective
- Lack of awareness of the problem

Today's Situation
- Tradition of inactivity
- Changing attitudes
- Contrast with more progressive nations – eg Scandinavia

Economics does not exist in a vacuum
- The economy as part of the larger environment
- Understanding the inter-relationships between economics, society and the environment – as a broad definition creates economic efficiencies
- EG Brodrene Hartmann

Industrial eco-systems

An industrial ecosystem is a community or network of companies and other organisations in a region who choose to interact by exchanging and making use of by-products and/or energy in a way that provides one or more of the following benefits over traditional, non-linked operations:
- Reduction in the use of virgin materials as resource inputs
- Reduction in pollution – increased energy efficiency leading to reduced energy use in the system as a

whole
- Reduction in the volume of waste products requiring disposal
- Increase in the amount and types of process outputs that have market value

Available options
- Maximise short term shock tactics – could cause public backlash
- Long term change – too little too late
- Reluctant responsibility – seen as a chore
- Activist and global recognition – seen as cutting edge

The Danish example
- Social co-operation
- Demystify technology
- Increase awareness of economic advantages and benefits of renewable energy to the general environment
- Create accountability

Lessons from Kalundborg
- All contracts have been negotiated on a bilateral basis.
- Each contract has resulted from the conclusion by both companies involved that the project would be economically attractive.
- Opportunities not within a company's core business, no matter how environmentally attractive, have not been acted upon.
- Each partner does its best to ensure that risks are minimised.
- Each company evaluates their own deals independently.

A better environment can save local communities
The village of Sevel, in northern Denmark, has around 800 people. It is a beautiful location with a scenic landscape. They have introduced 'green accounts'. "Life here is something we have to create ourselves."

District heating

Sevel plant type: heat and power using natural gas. More than 88% of all houses in Sevel are connected to the District heating network. The expenditure for the users is 20% less than previously used oil-based heating, taking into consideration all types of costs.

Focus on local resources
Island of Samso in Denmark - a 100% renewable energy society by 2010
Utilising natural resources such as wind, biogas, solar energy, construction of small decentralised heating plants fired by straw by 2010.

Self Sufficient in energy
The island of Aero in Denmark
- Large solar plant (covers 15% of heating requirements; in 2 years capacity is expected to increase by 50%; wind turbines and biogas will provide the balance)
- Production of 3,500 MWh corresponds to approx 3,500 tons of oil, reduces discharge of sulphur dioxide by 1.1 tons per annum, CO2 by 9,300 tons and nitrogen dioxide by 1.2 tons.

By-products of the oxygen wave plane
- Energy production
- Water treatment
- Extraction of minerals
- Extraction of living matter
- Production of fresh water
- Coastal protection

It has been done and it can be done …

Fuel cells as a solution for the use of renewable energy
- Fuel cells are electrochemical devices that convert a fuel's energy directly to electrical energy.
- Fuel cells operate much like continuous batteries when supplied with fuel to the anode (negative electrode) and oxidant (eg air) to the cathode (positive electrode).

Agenda 21, Rio Summit, 1992
- Develop new industries
- Pioneer innovative technologies
- Evolve fresh technologies, and
- Institute novel trade arrangements

Conclusion

- Emphasise a decentralised process

- Proactive engagement
- Create awareness
- Design policy through public/private dialogue and co-operation
- Link action and research
- Accountability
- Green accounts

A Simple definition of Sustainability

"Leave the world a better place than you found it.
Take no more than you need.
Try not to harm life or the environment.
Make amends if you do."
(Paul Hawken, The Ecology of Commerce)

Alexandra Hayles

Conclusions

"Life here is something we have to create ourselves ..."

Many of the people who have been involved with Dùthchas from the beginning are crofters. While crofters do disagree on details, we nevertheless share a common bond in the way that we view the world. The crofting way of life is a good foundation for keeping people in rural places and there is precious folk memory in crofting. It is also a good resource for potentially cutting our living costs and generating an income. That is why we all listened very carefully to the story of John Mackenzie from the Assynt Crofters' Trust. John had the foresight to see that the Trust would forever be dependent on voluntary labour unless they identified some core business activity that could generate a substantial income. It was extremely ambitious of him to undertake a hydro scheme, but he reached agreement with the environmental bodies and he engaged professional help when he needed it. The hydro scheme is up and running, and in the summer of 2000, the Trust was anticipating an income from the scheme of £1,000 per week. John has placed before us a challenge to seriously consider renewable energy schemes for the benefit of our communities. Indeed, his dedication and steadfastness are an inspiration.

These last several decades, our attitude to rural/croft housing has been to build a house as cheaply and as quickly as possible, with little consideration for the long term. The philosophy of "worrying about details later" is no longer acceptable though, and we are urged from all directions to build more responsibly. Scottish Homes are offering assistance towards an affordable, eco housing project in Trotternish, and that is an offer which we accept with gratitude. Housing consumes 25% of the UK's energy and we are cautioned to remember that it is easier to save energy than to create it. Low energy housing designs complement the spiritual ethos in the Findhorn community where people aim to live lightly on the earth. David Dittman lives and works close to Findhorn. A well planned eco design can be built for approximately £600 per square metre and it takes very little energy to heat. It includes 30 cm of wall insulation, 40 cm of roof insulation and high performance windows and doors. At Findhorn, a shared community generator paid for itself within five years. Other examples of living sustainably at Findhorn include the world class sewage system 'the Living Machine' which uses horticulture, as well as organic food production.

Wave power uses low or no carbon, but that is only one of its many positive features. If 0.1% of the potential renewable energy from oceans could meet the world demand for energy 5 times over, clearly investment in wave power could have a major positive impact on the world's people, its environment and its economy. Investment in wave power is expensive but we are advised that costs are reducing. Since its electricity generating power station joined the grid in 2000, Portnahaven on the island of Islay leads the world in wave power technology. David Langston informs us that there are sustainable jobs to be had in this growth industry. It is a potentially major export for the Highlands, and North Sutherland and North Uist have excellent wave power potential.

In countries without natural fossil fuels, systems like biomass have been the norm. The first fuels employed were wood and dung. It is modern, clean and carbon neutral, and there is employment to be had through crop production and harvesting. Warmth from locally produced wood waste is available at Broadford, Isle of Skye via Torren Heating, which is the first fully commercial wood fuel energy company in Scotland. Torren Energy and biomass cannot compete with natural gas, and so it is ideal for rural communities. Clients are billed for their hot water only. Service and maintenance are free, and the company guarantees the cost of heat up to 5 years in advance.

Denmark has invested heavily in wind energy, but until recently Scotland has not. In Skye's neighbouring island of Muck, Ingenco provides wind energy for the equivalent of two thirds of the national average via a non grid community scheme. Non grid machines can be maintained and handled by the community itself. In European terms, the north and west coasts of Scotland have the best wind speeds, and these could be applied to any of the three Dùthchas communities.

Renewable energy is part of life in Denmark and one in twenty people have invested in it. They are prepared to put their hands in their pockets. The Danes hold down 15,000 jobs associated with wind, and they account for 60% of the world's sales in wind. Decades ago, they had the foresight to invest in renewable energy, and this was witnessed first hand by the representatives of the Dùthchas communities who visited Jutland in May/June 2000. Since most of their local energy projects are community initiated, promoted, supported and used, the certainty of obtaining planning permission in Denmark is thus secured. That visit was an eye opener and certainly we are inspired by the country's wisdom and achievements.

How easy is it for ourselves to obtain the necessary permissions? We are cautioned by SNH's Landscape Advisor, Caroline Stanton, that although it can be done, it is incredibly important how a renewable energy

development is done in terms of the characteristics of the landscape and environment. Caroline advises us to assess the landscape for which type of renewable energy is suitable, rather than the other way around. Siting and scale are important, and SNH do have publications as a guide. Agencies and communities are again challenged to work together on this topic, and aims should be developed in relation to specific local conditions. Over and above environmental considerations, there are the sticky realities. Lack of spare capacity on the grid is the single biggest obstacle to renewable energy development in the Highlands and Islands. There is no infrastructure to transmit energy from here via cables. Elaine Hanton of HIE points out that although emerging technologies have good developmental potential in the Highlands and Islands, one of the major obstacles to development in the north is lack of support.

Alexandra Hayles advises that we have a quality of life which we must not take for granted. We need to think about future generations. She goes as far as to say that a better environment can in fact save a community. One Danish community described their experience to Alexandra by saying that, "Life is something we have to create for ourselves."

Our three Dùthchas communities have made a small but important start. Each has a vision. What is the starting point for action? Our groups believe that the way to start is to lead by example with a small group of enthusiasts. They want to demonstrate to crofters and the local community generally that you can do it. A start has been made by the selection of demonstration projects. The "RE" group in the Trotternish peninsula are grateful to Scottish Homes and to Lochalsh and Skye Housing Association for their offer to assist with the design and erection of an affordable eco housing scheme. This is their chosen demonstration project. Since the time of the seminar, Dùthchas held a round table meeting with a number of agencies, and a preliminary feasibility report has been prepared on our behalf by David Dittman of Eco tech Homes. North Sutherland selected a sustainable land use seminar, with a view to working towards creating a blueprint for sustainable land use. And for their demonstration project, the "RE" group in North Uist chose to link up with a local community organisation, Comann na mara, to potentially incorporate renewable energy devices into a proposed marine centre for North Uist.

And what of the longer term? Clearly we need to add our voice to the lobby for change. Renewable energy from wind, sea and water offers long term opportunities and the chance to significantly reduce fossil fuel consumption. Integrated community transport would reduce our use of fossil fuel energy in getting from A to B. We are very excited at the possibilities for renewable energy in our midst.

Concluding, our communities:

- Must build on the success of Dùthchas by continuing to work alongside the agencies
- Must engage professionals
- Must be aware that project costs for RE are significant
- Must go forward with an affordable eco house in Trotternish
- Must include planners for new thinking, new design and new materials
- Must encourage wave energy in Uist and Sutherland at least
- Are frustrated that Scottish public agencies talk about national policies when the issues are about local levels.
- Cannot wait for policies to change: we need to make things happen ourselves.
- Must work together on environmental issues.
- Should go on study trips to educate and motivate ourselves
- Should become more aware of biomass, particularly as a crofting crop
- Might adopt a community approach for wind turbines – Scottish Executive action now
- Should follow the Danish example: when the Danes want to do something they get together and plan it

We would like to take this opportunity to thank everybody who has participated to date in the renewable energy groups in Trotternish, North Uist and North Sutherland. Thanks are due also to the people on the reference groups who contributed their experience to help our local groups. We thank Columba 1400 for a lovely venue and buffet. Very many thanks to everybody who gave a presentation at the seminar in Staffin, as well as the wider community who attended as delegates. Many of you travelled a great deal of miles and took time off work to be present at our seminar. Final thanks go to the Seminar's chairman, Donald MacDonald, who kept a tight rein on proceedings. Taing mhòr dhan a h-uile duine agaibh.

"It Can be Done"
Gabhaidh e dheanamh a dh'aindheoin's na duileaghdasan.

Dùthchas, March 2001

Life

Dùthchas
Our Place in the Future

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