LERWICK DISTRICT HEATING SCHEME
After 15 years of success what’s next?

Neville Martin
Manager

Shetland Heat Energy and Power Ltd
WHERE ARE WE?

- Faroe (228 miles)
- Norway (225 miles)
- Aberdeen (211 miles)
LERWICK
Population 8000

ENERGY RECOVERY PLANT

PEAK LOAD BOILER STATION

INDUSTRIAL AREA

AREA BEING REDEVELOPED NEW MUSEUM Offices

COMMERCIAL

COMMERCIAL STREET

ANDERSON HIGH SCHOOL

SOUND SCHOOL

SPORTS CENTRE CAMPSITE HOSPITALS

BELLS BRAE SCHOOL LERWICK HOTEL HEALTH CLINIC

3 CARE CENTRES FIRE STATION

MINOR EXTENSIONS AND CONNECTIONS ONGOING

PHASE 1 (1998/9)

PHASE 2 (2000/02)

PHASE 3 (2004/07)

COMMERCIAL STREET

PHASE 1 (1998/9)

PHASE 2 (2000/02)

PHASE 3 (2004/07)

MINOR EXTENSIONS AND CONNECTIONS ONGOING

MINOR EXTENSIONS AND CONNECTIONS ONGOING
ENERGY RECOVERY PLANT
Operated by Shetland Islands Council

- Output 6.3MW - currently 80% efficient - 90% availability
- 22,000 tonnes of waste per annum
  - Includes waste from Orkney, offshore oil industry and Highland
- Flue gases continually monitored
DISTRICT HEATING
Peakload Boiler Station

SHELTON HEAT ENERGY AND POWER

- Purchases all the heat from the Council
- Controls system and pumps - can be operated from home and ERP
- 14.5MW back up boilers for peak demand or ERP downtime with space to upgrade to 19.5MW
- Blends incoming 110C water with return water to put out 95C

ELECTRICITY POWER STATION
60MW and only 40% efficient
LERWICK Population 8000

ENERGY RECOVERY PLANT

PEAK LOAD BOILER STATION

SOUND PUMPSTATION

HHA QUOYS HOUSING DEVELOPMENT 2005 onwards

PHASE 1 (1988/9)
PHASE 2 (2000/02)
PHASE 3 (2004/07)

Minor extensions and Connections ongoing
QUOYS
Hjaltland Housing Association Scheme – 120 houses
Future Extension?

From pump house

100% connected – including 15 private houses
WHAT HAVE WE ACHieved BY SEPT 2013?

SINCE NOVEMBER 1998 WHEN WE FIRST SWITCHED ON

• **1175** properties live, 30km of mains
  - in line with our forecast (50% of properties within vicinity of pipes)
  - 1200 actually connected
  - Approximately 1035 houses and 115 non domestic
  - Freeze on new extensions despite demand
  - Over 10% of all central heating in Shetland – although we only serve Lerwick

• **Now the only “utility” under local control**

• **SEEN AS ENVIRONMENTALLY THE WAY FORWARD**
  - By customers
  - By SEPA
A highly desirable product

102 St Olaf Street, Lerwick

Rare opportunity to purchase an immaculate detached four bedroom property with wonderful original features throughout in sought after location. Large dining kitchen, elegant living room, utility, large family bathroom and study/5th bedroom. Garden with outbuildings. Lovingly decorated, district heating and double glazing. Home report available.

Offers invited over £250,000

Viewing highly recommended, contact 07557642638.
SHETLAND DOMESTIC FUEL PRICES

Note:
Most electricity customers will be paying more than shown.
Oil price does not include for maintenance costs which will be similar to standing charges.

Note: NO MAINS GAS TO COMPETE WITH
LERWICK DISTRICT HEATING
WHERE THE HEAT GOES

Breakdown of Percentage Customer Type on District Heating Scheme By Usage

- Housing (300 Houses owned by council, Hjaltland, and 750 Privately owned Houses) - 38%
- Leisure - 11%
- Industrial, Transport and Garages - 7%
- Retail, Offices and Guesthouses - 6%
- S.I.C. and other Public Buildings - 22%
- Health and Care Houses - 16%

62% GOES TO NON-DOMESTIC - needed to keep scheme viable
LERWICK DISTRICT HEATING
ECONOMIC ACHIEVEMENTS
September 2013

• Most District Heating income (£2,000,000) stays in Shetland – Promoting a more sustainable Shetland economy.

• Customer savings on fuel costs about £1,250,000 at $100 a barrel

• Large customers
  – New build £X00,000 in capital costs
  – Maintenance £X00,000 – often staff redeployed on other works

• New Works up to 100 connections pa
  – Connections £400,000pa (of which 75% is local input)
  – Plumbing works £400,000pa+
  – Has come to an end by 2011 until another cheap heat source is developed
LERWICK DISTRICT HEATING
ECONOMIC ACHIEVEMENTS
September 2013

TOTAL BENEFIT
£3+ MILLION per annum
Cost to date £14M

Plus Environmental Benefits
LERWICK DISTRICT HEATING
ENVIRONMENTAL ACHIEVEMENTS
UP TO 2013

- Fossil Fuel saved 6000 tonnes
  - At the 2009 peak this would have cost £700 a tonne representing over £4M most of which would go straight out of the Shetland economy

- Carbon Dioxide reduction 15,500 tonnes
  - About 0.7tonne per capita
WHAT NEXT?
We will need another cheap heat resource this year if we are to continue to expand.

- CHP from the new power station - possibly going into mothballs.
- Waste oils – including from processed diseased fish from fish farms
- Biomass – CHP unlikely
- Industrial waste heat including from refrigeration (35°C)
- Heat pumps- from the sea or sewer?
- Geothermal
- WIND TURBINES
3No 2MW Wind Turbines
46% Load factor

Landfill site
Recycling Centre
Energy Recovery Plant

Site of new power station
SSE POWER STATION

Shetland is not on the National Grid

Vacant tank base for 135MWh tank?

Heat Pump into sewer?

Heat Pump into sea?
In Denmark electricity prices often went negative due to wind power. This resulted in district heating schemes getting paid to take the electricity. Take-up has removed this.
3No 2 MW Wind turbines

Hydrogen Production

For grid stabilisation
Up to 2.5 MW

Storage required

Scottish and Southern Power Station

Possible Add-ons
- not part of NINES!!!

TRANSPORT

For grid stabilisation
0 to 4 MW

33kVa

To the Shetland Grid

Storage Battery

Lerwick District Heating Scheme

CHP at Energy Recovery Plant

Heat

Electricity

Thermal Storage Tank
Lerwick District Heating Scheme

3No 2.3MW Wind turbines

Hydrogen Production

Methanol

Petrol

Up to 2 tonnes per day?

Scottish and Southern Power Station

Storage

Battery

Possible Add-ons

-not part of NINES!!!

Thermal Storage Tank

Electricity

CHP at Energy Recovery Plant

Methane

Storage required

To the Shetland Grid

Heat

Storage required

For grid stabilisation

Up to 2.5MW

CO₂ From ERP

For grid stabilisation

0 to 4MW

33kVa

Methanol

Storage required

Energy Recovery Plant

For grid stabilisation

Up to 4MW

Lerwick District Heating Scheme

Lerwick District Heating Scheme

Lerwick District Heating Scheme

Lerwick District Heating Scheme

Lerwick District Heating Scheme
A problem with seasonal demand

Problem: Find a use for surplus heat and electricity during the summer.
North Energy Biomass Production Project

Gremista - Summer operation

- Biomass drying store
- Thermal Store
  Temp maintained at 80 deg
- Metered heat
- SHEAP network
- Metered Electricity
- Electricity sales
NORTH ENERGY BIOMASS PRODUCTION PROJECT
Gremista - Winter operation

Thermal Store
Temp maintained at 80 deg

Biomass drying store
Biomass boiler

Metered Heat

SHEAP network

Metered Electricity
Electricity Sales

Metered Heat
NORTH ENERGY BIOMASS PRODUCTION PROJECT
Potential interaction with SHEAP

Energy flow

Diesel displacement
Heat purchased from Sheap
Energy Recovery Plant

Shetland Heat Energy & Power
PEAKLOAD BOILER STATION

115C  55C

12MWh Thermal Storage

14.5MW Oil Boilers

0.4MW Biomass
0.5MW wind turbine

6.3MW

2 MW Oil Boilers

1.5MW Oil Boilers

2 MW Oil Boilers

3 CARE CENTRES

ANDERSON HIGH SCHOOL

ISLESBURGH

GILBERT BAIN HOSPITAL

MONTFIELD HOSPITAL

CLICKIMIN SPORTS CENTRE

OLD LERWICK

2.5MW Oil Boilers

SOUND AREA

New Housing Developments

QUOYS PUMPING STATION

NORTH NESS AREA
Includes museum, arts complex and business park

TWAGEOS
LERWICK DISTRICT HEATING SCHEME
Schematic Diagram Jan 2016?

Shetland Heat Energy & Power
PEAKLOAD BOILER STATION

115C  55C

14.5MW Oil Boilers

6.3MW Energy Recovery Plant

12MWh Thermal Storage

2 MW Oil Boilers

12MWh Thermal Storage

0.4MW Biomass
0.5MW wind turbine

1 MW Biomass?

NEW HIGH SCHOOL

CLICKIMIN SPORTS CENTRE

OLD LERWICK

0.5 Bar

MONTFIELD HOSPITAL

ISLESBURGH

ANDERSON HIGH SCHOOL

TWAGEOS

0.5 Bar

NEW HIGH SCHOOL

1 MW Biomass?

0.5 Bar

MONTFIELD HOSPITAL

ANDERSON HIGH SCHOOL

TWAGEOS

0.5 Bar

SOUND AREA

New Housing Developments

QUOYS PUMPING STATION

GILBERT BAIN HOSPITAL

0.5 Bar

3 CARE CENTRES
Even if an interconnector is laid a new oil fired power station has to be built by 2017 for security of supply.

Will it operate if the price of heat is right? If not we will need a larger heat source.
LERWICK DISTRICT HEATING SCHEME
Schematic Diagram 2017 - If no heat from the new power station

- Energy Recovery Plant: 6.3MW
- PEAKLOAD BOILER STATION: 14.5MW Oil Boilers, 2 MW Oil Boilers, 12MWh Thermal Storage
- Shetland Heat Energy & Power: 3 CARE CENTRES
- Old Lerwick:
  - MONTFIELD HOSPITAL
  - GILBERT BAIN HOSPITAL

New Heating Developments:
- SOUND AREA: QUOYS PUMPING STATION
- NORTH NESS AREA: Anderson High School, Islesburgh
- TWAGEOS: 3 MW Heat Pump in the sea, 12 MWh Thermal Store
- TWAGEOS: 2.5MW Oil Boilers
- SOUND AREA: New Housing Developments
Taking Heat Out Of The Sea
- once we know what is happening with the new power station

14 MW, 90°C, District heating
3 x 2 stage 4.6 MW Systems

---

COP_heating = 3.0

Evaporating temp. 2°C
Sea water 8 to 4°C

Condensing temp. 89°C
District heating water 60 – 90°C
Stockholm has a 180MW Heat Pump abstracting heat from the sea since 1986
LERWICK DISTRICT
HEATING SCHEME
Schematic Diagram 2017 - If no heat from the new power station

6.3MW Energy Recovery Plant

14.5MW Oil Boilers

0.4MW Biomass
0.5MW wind turbine

2 MW Oil Boilers

12 MWh Thermal Storage

3 MW Heat Pump in the sea

12 MWh Thermal Store

Shetland Heat Energy & Power
PEAKLOAD BOILER STATION

115C

55C

95C

55C

OLD LERWICK

NEW HIGH SCHOOL

1 MW Biomass?

CLICKIMIN SPORTS CENTRE

MONTFIELD HOSPITAL

ISLESBURGH

ANDERSON HIGH SCHOOL

TWAGEOS

SOUND AREA

New Housing Developments

QUOYS PUMPING STATION

GILBERT BAIN HOSPITAL

3 CARE CENTRES

NORTH NESS AREA
Includes museum, arts complex and business park

0.5 Bar

0.5 Bar

0.5 Bar

0.5 Bar
## RHI tariff rates 2013/14

<table>
<thead>
<tr>
<th>Generation Technology</th>
<th>Scale (installation capacity)</th>
<th>RHI tariff payment/kWh (p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomass</td>
<td>Small commercial (&lt; 200kWth)</td>
<td>8.6/2.2</td>
</tr>
<tr>
<td></td>
<td>Medium commercial (200kWth &lt; 1MWth)</td>
<td>5.3/2.2</td>
</tr>
<tr>
<td></td>
<td>Large commercial (&gt;= 1MWth)</td>
<td>1.0 (Hopefully 2 for next year)</td>
</tr>
<tr>
<td>Heat pumps/deep geothermal</td>
<td>Small commercial (&lt; 100kWth)</td>
<td>4.8</td>
</tr>
<tr>
<td></td>
<td>Large commercial (&gt; 100kWth)</td>
<td>3.5</td>
</tr>
<tr>
<td>Solar collectors</td>
<td>&lt; 200kWth</td>
<td>9.2</td>
</tr>
<tr>
<td>Biomethane and biogas combustion</td>
<td>&lt; 200kWth</td>
<td>7.3</td>
</tr>
</tbody>
</table>
Problems with RHIs and Large DH schemes

- RHIs encourages small schemes.
- As we add numerous small individual developments receiving RHIs the total will exceed the threshold and they will all be downgraded.
- What are the losses in the system? The additional plants come on only to meet peak loads – the heat losses are already accounted by that supplied by the ERP.
How to Maximise Renewable Heat Incentives

Suppose the average consumption is 25kW (219,000kWh) throughout the whole year, but you put in a 199kW boiler for peak demand – a school would only heat from say 8am to 4pm.

\[
199 \times 365 \times 24 \times 15\% = 261,486 \text{ kWh} \quad \text{which is greater than 219,000}
\]

Therefore all heat \(219,000 \times 8.6p = £18,834\) RHI

If you only put in a 60kW boiler and start it up earlier or put a thermal tank

\[
60 \times 365 \times 24 \times 15\% = 78,840 @ 8.6p = £6,780
\]

\[
140,160 @ 2.2p = £3,083
\]

\[£9,863\]

ie about £9,000 pa less over 20 years
GEOTHERMAL?

Abstraction via Heat Pump

Seasonal Storage
How the fuel mix in Gothenburg’s District Heating system has changed over the years.
Scotland’s Current Energy Split

Most heat is from fossil fuel
It has to be the main target for carbon reduction
Scotland’s Possible Future Energy Split?

- Other heat
  - In rural areas: Biomass? Heat pumps? Wind? Solar?

- Transport

- Electricity

- Electricity from EfW

- Heat from district heating:
  - District heating could achieve the lion’s share of carbon savings!
  - Is using the waste heat from power stations in District Heating better than Carbon Capture?

- Other heat from:
  - Waste heat from power stations
  - Industry such as Grangemouth

- THERMAL WASTE HEAT
These figures are a realistic estimate of what could be achieved technically. They do not mean that this is appropriate or even desirable in either social or economic terms, or that Government funding would be available to support this. There are many different scenarios and options for reaching future targets. Each different combination will give slightly different costs and take-up rates of specific technologies. The following summarises two example scenarios - one a business-as-usual baseline, the other estimated to meet climate change targets.

**Figure 6.5: CO₂ emissions reductions from applying energy efficiency measures**

<table>
<thead>
<tr>
<th>Upgrade Option</th>
<th>Saving/2005 (MtCO₂)</th>
<th>Percentage savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cavity wall insulation</td>
<td>0.80</td>
<td>7%</td>
</tr>
<tr>
<td>Solid wall insulation</td>
<td>1.62</td>
<td>14%</td>
</tr>
<tr>
<td>Loft insulation</td>
<td>0.41</td>
<td>3%</td>
</tr>
<tr>
<td>Short term package: Draught proofing</td>
<td>0.47</td>
<td>4%</td>
</tr>
<tr>
<td>Pipe lagging</td>
<td>0.19</td>
<td>2%</td>
</tr>
<tr>
<td>Shutters</td>
<td>0.07</td>
<td>1%</td>
</tr>
<tr>
<td>Radiator shelves</td>
<td>0.10</td>
<td>1%</td>
</tr>
<tr>
<td>Radiator foils</td>
<td>0.05</td>
<td>0.4%</td>
</tr>
<tr>
<td>Cylinder insulation</td>
<td>0.04</td>
<td>0.3%</td>
</tr>
<tr>
<td>Low energy lights</td>
<td>0.10</td>
<td>1%</td>
</tr>
<tr>
<td>Solar water heating</td>
<td>0.91</td>
<td>8%</td>
</tr>
<tr>
<td>Double or secondary glazing</td>
<td>0.15</td>
<td>1%</td>
</tr>
<tr>
<td>Advanced heating controls</td>
<td>0.13</td>
<td>1%</td>
</tr>
<tr>
<td>Boiler upgrade</td>
<td>1.08</td>
<td>9%</td>
</tr>
<tr>
<td>Biomass boiler</td>
<td>1.49</td>
<td>12%</td>
</tr>
<tr>
<td>Combined heat and power (CHP)</td>
<td>1.61</td>
<td>13%</td>
</tr>
<tr>
<td>Ground Source Heat Pump (GSHP)</td>
<td>0.48</td>
<td>4%</td>
</tr>
<tr>
<td>Air Source Heat Pump (ASHP)</td>
<td>0.57</td>
<td>5%</td>
</tr>
<tr>
<td>Community heating with CHP</td>
<td>6.78</td>
<td>56%</td>
</tr>
<tr>
<td>Improved electrical appliances</td>
<td>0.05</td>
<td>0.4%</td>
</tr>
<tr>
<td>Photovoltaic</td>
<td>0.55</td>
<td>5%</td>
</tr>
<tr>
<td>Wind turbine</td>
<td>0.20</td>
<td>2%</td>
</tr>
</tbody>
</table>
IS WASTE HEAT CAUSING OUR CLIMATE TO CHANGE?

We should not be wasting finite resources

**HEATING THE WORLD**

OUR CARS, HEATERS and air-con units (pictured inset) are causing temperatures to change in cities hundreds of kilometres away. US scientists have worked out the knock-on effects of technology that takes in energy and throws out waste heat. They ran a climate model twice – once including figures for waste heat produced by technology and another without this extra heat, to see its effect over a period from December to February. It is thought our waste heat causes its climate-changing effects by shifting jet streams, so some areas are cooled while others heat up.

“Energy use from multiple urban areas can collectively warm the atmosphere thousands of miles away from where the energy was consumed.

Guang Zhang, University of California, San Diego

Winter temperature changes due to waste heat (°C)
LERWICK DISTRICT HEATING

HEATING PERFORMANCE
Lerwick District Heating Scheme
Shetland Heat Energy & Power

- Resource efficiency: 0.42 Primary Energy Factor
- Renewability: 89% Renewable & Surplus heat
- CO₂ efficiency: 95 kg/MWh

Valid 12/2012 until 12/2013
Reference number GB-00004
www.Ecoheatcities.eu

www.sheap-ltd.co.uk

2011 Paper on Institution of Civil Engineers Virtual Library
Whilst you are waiting for HS2

RAIL NIGHT
Plus some lorries and buses by popular request
Now in our 8th year!!!
A COLLECTION OF FILMS OF
GENERAL INTEREST ON RAILWAYS
SHOWN ON THE LARGE SCREEN

HOSWICK VISITOR CENTRE

7.30pm WED 6th NOV
Whilst people are turning up there will be a showing of films of
some model railway layouts
Films include:  (May be subject to change)

- Look At Life  (As shown at the Odeons in colour 1959)
- Steam Under Strain
- London On The Move (Buses and Trains)
- Link Span  (BT film 1956 of Boat Train)
- Plus many more

£2.50 Adults
£1 Youth

Proceeds to the Hoswick Visitor Centre
Refreshments Available