Development of Sustainable Biomass and Local Community District Heating Systems in Shetland

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GS CONSULTING AND SERVICES

Presentation Overview

- SRC as a potential fuel source
- The wood biomass supply chain
- Situation in Orkney
- Situation in Shetland
- The willow and poplar biomass trials
- The future

SRC as a Fuel

- **SRC becomes more viable as oil costs increase**
- **Energy content of the dry wood is about 19 MJ/kg**
- **Energy from 10 odt of chips approximately equivalent to 4,000 l heating oil or 4 t coal**
- **Average yield is about 6-8 odt/ha/yr**
- **An average 3-bedroom house:**
  - Uses 3,000 l heating oil
  - Equivalent to 7.5 odt wood chips or about 1 ha of willow.

Household Pellet burner for heating and hot water

The Wood Biomass Supply Chain

Production → **Harvesting & Processing** → **End- Users**

Potential Producers

- Farmers
- Large Estates
- Crofters
- Smallholders

Potential End users

- Private landholders – Housing, outbuildings
- Councils – district heating systems, swimming pools, schools, leisure centres, offices
- Private sector – offices, warehouses, medium to large buildings, district heating systems
- Government – Hospitals, Offices, medium to large buildings

Situation in Orkney

- **Agriculture and tourism main industries**
- **Population of just over 20,000**
- **70% households use oil heating and homes need heating +25% more than the U.K. average**
- **The Orkney Islands have rich agricultural soils compared to Shetland and the northern mainland. 60% is arable or improved pasture**
- **Main agricultural business is grass production and cattle**
- **The climate is categorised as hyper-oceanic:**
  - Average temp range +2 – 20^{o}C
  - 900-1000mm rainfall
  - Increased day length
  - Salt laden winds

Situation in Orkney

- Lynn Road development
  - 40 houses were connected to the District Heating system
  - Wood-fired boiler - community heating (hot water)
  - 150-200 odt/yr of wood chips – 15 to 20 ha of willow
  - Was going to use willow from already existing and new Orkney College plantations and scrap wood.

But:

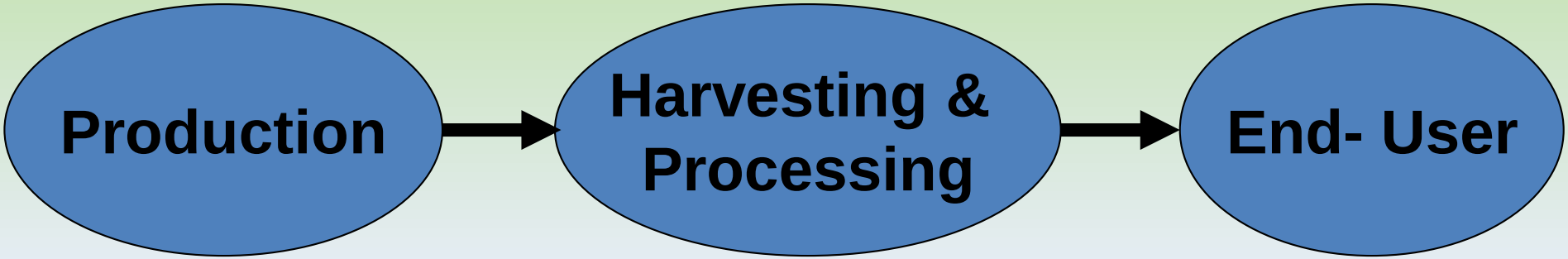
- It went wrong from Day 1
- Poor fuel quality control, defective piping and metering.

Lynn Road biomass boiler being delivered

Extent of Lynn road development DHS

Consequences for Orkney

- The wood biomass supply chain broke down In effect the market is being pushed by excess woodfuel biomass with no market
- Orkney College was left with willow plantations and no market
- OIC and OHAL have never seriously looked at biomass as a alternative fuel since which has stopped the growth of this fuel source dead in its tracks
- Market now restricted to individual householders and small holders with the exception of Balfour Castle which is investing in biomass to heat its properties



Situation in Shetland

- **Economy is Oil, Fishing, aquaculture, sheep farming and tourism**
- **Population is around 21 000**
- **70% of households use oil for both electricity and heating and need heating 25% more than the U.K. average**

- **Only 16% of land is arable or improved pasture standard, mainly in the bottom of valleys and coves. This has to provide for all arable production. The rest is hill grazing for sheep**
- **The climate is categorised as hyper-oceanic:**
  - Average temp range +2 – 15 C
  - 1 220 mm rainfall (half that of west coast of Scotland)
  - Increased day length
  - Salt laden winds

Lerwick oil fired power station

Situation in Shetland

- There is a demand now for biomass but little indigenous fuel
- Being led by Angus Grain, a sort of John Gilliland of Shetland.
- He was having problems with meeting heat efficiency standards in the building he was renovating.
- Air source heat pumps did not last long
- He decided to privately invest in biomass energy and build the infrastructure and expertise to install 'off the shelf' biomass and small district heating systems.
- The supply chain is being '*pulled*' by an end user that is providing a market.

Infrastructure in Shetland

Dry storage and boiler building

- 1600 m^3
- Under construction
- Will process wood into pellets (300 kg/hr)
- These will be sold, used to feed biomass boilers around the county or used on site in conjunction with the Lerwick District heating system

Situation in Shetland

- Fuel source at present is
  - Waste wood from Petrofac (Contractor for Total)
  - Clean waste wood
  - Packaging
  - Imported wood

Biomass boiler

Waste, shredded wood

Use of heat from Lerwick Pellet and Chip plant

- The pellets will be used to dry the wood before processing during
- In winter, plant will feed hot water into Lerwick District Heating System and in summer will take excess heat from LDHS to dry the waste wood.
- Cost to end-users fixed to price of oil
  - **Current cost is 5.9p/kwh when price of oil is 8.1p/kwh**

Building exterior

80 m^2 floor under construction

Pellet hopper and feed system

Other small district heating systems in Shetland

- Brae
  - 150 000 kwh/yr pellet boiler
  - Feeds the Swimming pool and sports centre changing rooms
- Aith
  - Swimming pool
- Yell
  - School and leisure centre

- Shetland Recreational Trust aim to install 8 biomass systems at their pools and leisure centres in the near future


Brae boiler room

Brae biomass boiler


Brae Changing rooms

The Biomass Wood Research Project

- Fuel has to be imported so no more secure than oil
- Growing biomass in Shetland is more environmentally sustainable and would give an alternative income to farmers
- There is a existing market to take the fuel in Shetland. It is not speculative, c.f Orkney

But

- Good land is scarce in Shetland and is needed for other agricultural purposes. This has led to some opposition from SIC in the past but has support of local crofters

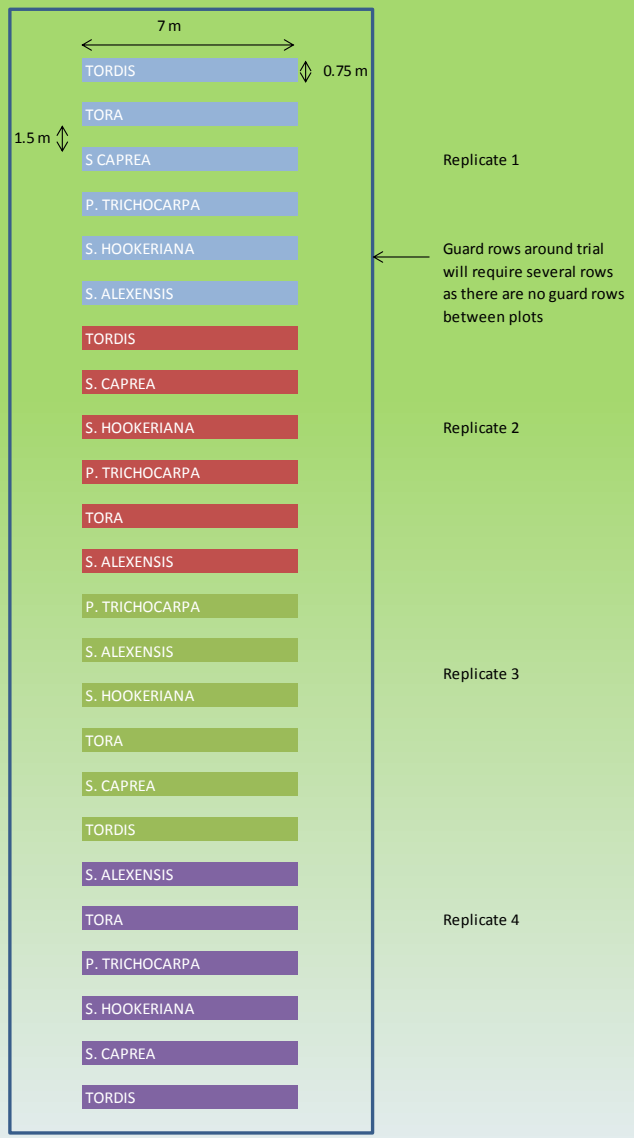
The Biomass Wood Research Project

- Trial set up in 2013 to investigate which willows and a poplar would grow well in Shetland
- Varieties chosen on the basis of what varieties already grew well in Shetland and the best results from the Orkney Trials.
- Trial on good agricultural land owned by Angus Grain
- Been run on a shoestring up to now with free time being given by everyone

The Biomass Wood Research Project

SHETLAND WILLOW PROJECT

Not to scale



- 5 varieties of willow and one poplar
  - *Salix caprea* (Goat willow. Used for amenity and shelterbelt purposes)
  - *S. alexensis* (Alaskan variety used for amenity and shelterbelt purposes)
  - *S. Hookeriana* (Alaskan variety used for amenity and shelterbelt purposes)
  - *Populus tricocarpa* (Black cottonwood. Used for amenity planting and shelter
  - Tora (Swedish willow variety)
  - Tordis (Swedish willow variety)
  - Endurance (British willow variety)

The Biomass Wood Research Project

- Aims
  - Measure survival, yield and growth parameters
  - Investigate whether amenity varieties are suitable for energy production compared to standard energy varieties
  - Investigate whether it is possible to grow willow or poplar on lower quality land.

The Biomass Wood Research Project: The Future

- Applied to the Climate Challenge Fund for
  - funding for the present trial for another 2 years
  - Pay for collection and analysis of the data
  - Set up another trial on lower quality land
  - To set up an educational programme to show the benefits of biomass heating in Shetland and to provide best practice guidance about growing willow in Shetland

In Conclusion

- Shetland has a market for wood fuel
- This market can be used to develop an indigenous biomass sector
- Orkney has no major market for wood fuel
- Yet Orkney is producing wood fuel for which there is no market
- It should be possible to sustainably produce wood fuel in Shetland, providing we know what varieties of willow/poplar to grow and what the yields will be