Biofuels
Putting together the Green Jigsaw

Project Title:	Capacity Building in South Africa, Namibia and Ghana to Create Sustainable, Bio-oil Supply Chains
Lead	University of Greenwich
Partners	Turner & Townsend (Pty) Ltd, South Africa University of Namibia, Namibia University of Ghana, Ghana Jatropha Africa Ltd, Ghana Goldex 35 (Pty) Ltd, South Africa Consorzio di Ricerca per lo Sviluppo di Sistemi Innovativi Agroambientali (CoRiSSIA), Italy Marine Biological Association, United Kingdom

Reporting Template

Case Study title **Helius CoRDe (**Helius CoRDe Ltd is a joint venture company created by Helius Energy Plc and The Combination of Rothes Distillers (CoRD). The company is a private company limited by shares with the three shareholders being Helius Energy Plc, The Combination of Rothes Distillers Ltd and Rabo Project Equity B.V. The venture was created in order to reduce the carbon footprint of the whisky industry within the area of Speyside, Scotland.**)**

Name of reporter **Katie Thompson**

Contact details **k.m.thompson@durham.ac.uk**

Time period of interrogation **December 2012-March 2013**

Methods used in interrogation **Internet searching grey literature search, telephone and email correspondence, face to face interview.**

Stakeholders interviewed- title, position in organisation **Andrew Wood, Plant Manager**

Any permissions / restrictions on use of information **No negative reporting, check with contact for permissions with regards to use.**

The Biofuel/energy supply chain

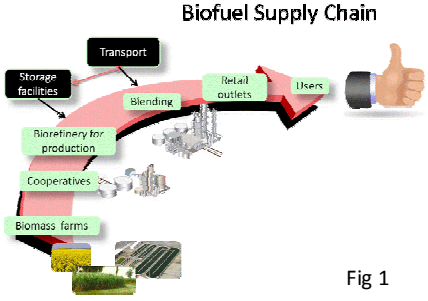

Fig 1

With reference to fig 1, give an overview of the full biofuel supply chain that the case study forms a part, both as it exists now and/or as is planned.
Include details of
a) Biomass feedstock – The feedstock used is draff and woodchip. The draff is supplied from the local distilleries under the CoRDe group and the woodchip is supplied from two suppliers both within a 20 mile radius of the plant.
b) transportation methods to ship biomass to processing units; The by-products are transported by lorry and travel no more than twenty miles to the plant. The animal feed syrup produced is collected by British Sugar. Helius CoRDe are unaware of the ongoing supply chain for this product.

c) key technologies used in biorefineries / blending operations; (Please see Appendix ***)*** *However, the CHP plant comprises a conventional grate boiler in which the fuels are combusted to generate steam which is used to generate electricity in a steam turbine-generator set and part of which is supplied to the adjacent pot ale processing plant.*

d) Retail outlets and end-users, including any international export markets involved. The electricity generated is fed directly to the grid, other by-products are collected by the purchasers and the ongoing supply chain is unknown.

The case study. *Give a brief overview of the case study, its size of operation, the business model, when it was initiated and by whom, and how long it was/has been operational for. Indicate the sources of funding, any written or contractual agreements with suppliers of either equipment supplies, or of biomass sources as relevant.*

In order to utilise the whisky by-products generated in the Speyside area, the project involved building a 7.2MWe biomass Combined Heat and Power plant (CHP), being fuelled by pot ale (the liquid co-product of whisky production) and wet draff received from the CoRD distilleries, as well as being supplemented by locally sourced, sustainable woodchip, and converting this into organic fertilizer, high-grade animal feed in addition to producing enough electricity, if fed back to the grid, for 9,000 homes and their electricity requirements.

This plant was unique for the in that it was the first to use Pot Ale as well as the first 5-8MWe GreenSwitch project. These are modular biomass power stations which are capable of utilising wet biomass and which are located alongside existing industries which produce suitable co-products.

Development of the plant began eight years ago in 2005 with feasibility and grid connection studies. However, the Helius CoRDe joint venture was established in 2009 following planning permission being achieved.

In order for a CHP of this size to be viable and the carbon footprint to remain low, Helius recognised that there needed to be a large conglomerate of distilleries to supply the waste to fuel the boiler. Within the Speyside area this amounts to over 500,000 tonnes of draff and 1,500,000 tonnes of pot ale co-products per annum. A proportion of this waste is already delivered to the site which contains two existing plants. There has been a by-product facility on the site since 1904, but the two existing evaporators were built in 1971 and 1974 and are therefore nearing forty years and thus the end of their natural life. At present, running these two evaporators costs approximately £3,000,000 in fossil fuel per annum. Part of the projects plan and reason for choosing the site they have, was to decommission these two evaporators, saving not only £3,000,000 per annum in fossil fuel, but also reduce the carbon footprint generated in processing the distilleries by-products. A further reason for selecting the location they have was due to the workforce already being skilled in the area and they can be trained in the operation of the new plant, meaning no loss of employment and little training being required.

Funding
When the project was first discussed, there was only going to be a basic draff boiler built on a circulating bed with projected costs of £20-25million for a 5MW plant. Helius was going to put between £4,000,000 and £5,000,000 into the project and obtain finance on the remaining £20million (the usual 30% to 70% debt to equity ratio). However, as the project grew and the economics of it were investigated from 2007-2008 the costs increased. Due to a transition period where double ROCs were announced for CHP, it made economic and environmental sense for Helius CoRDe to build an evaporator to replace the existing two and continue to produce animal feed also, rather than just being a renewable energy electricity producer. By the time they got boiler prices back in 2010 they were looking at 35million Euros and the costs of the constituent parts of the project were projected at £42million. Consequently, more debt was required and this wasn't

easy to obtain, as Andy explains "it was a partnership because it came just after the financial crash, so no bank would lend more than £30million so we had to have a two-bank consortium". The company wanted a ratio of 70/30% however, it has resulted in a 60/40%. As Helius could no longer put the money in, as it was too expensive, an additional equity partner was required in order for the project to move forward. As the total projected cost of the project was approximately £60.5 million the project has therefore been funded as follows; £7.85 million provided by the company (comprised of its equity investment and its development costs contribution which was converted to equity), the CoRDe Project has been financed by a non-recourse senior debt facility of £42.4 million, with £1 million of development funding being provided by The Combination of Rothes Distillers Limited and the balance being provided by Rabo Project Equity B.V. (a wholly owned subsidiary of Rabobank Group). The £42.4 million in project financing was secured from Lloyds Banking Group and the Royal Bank of Scotland. Consequently, Rabo Project Equity acquired a 44.7% stake in the project, with The Combination of Rothes Distillers retaining a 5.3% share and Helius Energy owning 50%.

A further problem arose with regards to the funding as the project was viewed as a 'risk' according to the venture capitalists, as biofuels are still perceived as being an innovative technology. According to Andrew Wood, their plant involved very little new technology as *"biomass boilers were around before coal burner boilers and biomass was around…you look at every student that writes their thesis or dissertation and biomass started with the caveman when we rubbed two sticks together and biomass fire, all they do in the boiler is put biomass into a boiler so biomass boilers have been around since before coal boilers…"* [107-111].
Initially, Andy explained how it started off with banks interviewing the company, but ended with Helius CoRDe interviewing them, as although venture capitalists seemed keen to invest in green credentials, when the company asked for the interest rates it became apparent that they weren't really serious about the project due to underlying uncertainty as these were exceptionally high: ,

> *"it was interesting we started, or banks starting interviewing us and then we started interviewing banks because we had a lot of interest. There is a lot of interest even though it's risky and the uncertainty, the interest was there as everyone wants their finger in the green pie and the environmental pie, but you could tell from when we asked for their rates for borrowing money that people weren't really serious on some companies*" [122-127]

This uncertainty was still present with the banks who eventually gave the loans as they insisted on 12-year contracts being put in place. For example, no companies within the UK make the boilers relevant to this project and due to it therefore being a European boiler the banks requested that they hedge the Euro by requesting a floor in the power price contract. In order to secure these long-term contracts it meant that the company had to go to larger suppliers and this meant more money. The woodchip for example, there is a supplier 6 miles down the road who is much cheaper, who they do purchase their virgin wood off, but they have a contractual obligation with a larger supplier to fulfil the banks requirements. An upside of this contractual obligation was that this large woodchip supplier set up a depot 20 miles away, reducing the carbon footprint. Furthermore, the distillers agreed that if the electricity drops below a certain level they will step in and cover the cost, taking the risk were the banks wouldn't, as Andy explains:

> *"Although we have a floor for the electricity proce, which is lower than the price, the distillers stepped up to the table and said if the price drops below I think its £50 or something, if the electricity price drops,*

they will actually contribute to the project, because they wanted the project." [568-571]

Finally, due to some of the changes in the project plan Helius CoRDe are now further into their contingency, although Andy does not know the exact figure, than they should be according to their projections. Upon interviewing Andy Wood, any more costs on to the project and it wouldn't have been able to go ahead. For example, the entire development fee Helius received for the project has been put back in to the project – Helius has not taken any money out of the project.

The CHP Plant

The CHP plant comprises a conventional grate boiler in which the fuels are combusted to generate steam which is used to generate electricity in a steam turbine-generator set and part of which is supplied to the adjacent pot ale processing plant.

The plant was designed to combust DG at a rate of 8.5t/h (corresponding to approximately 115,000 tonnes per annum of wet draff) supplemented by woodchips (at 50% moisture content) at a rate of 7.2t/h. The boiler, however, is designed to be capable of processing up to 150,000 tonnes per annum of wet draff and could, should the need arise, run on woodchips only.

The steam is extracted from the low-pressure end of the turbine and supplied to the process plant at 11.91t/h. The spent steam from the turbine is condensed in a condenser, cooled with water from a cooling tower (using grey water), extracted under license, from a local burn and treated process effluent. The condensate is then recycled to the boiler. Hot flue gas is cleaned through the injection of urea and lime and passed through bag filters to remove ash and particulates in the gas stream, prior to venting to the atmosphere via a tall stack.

The process plant comprises a conventional sextuple effect pot ale evaporator plant and associated equipment. The plant uses steam from the adjacent CHP plant to heat and evaporate the incoming pot ale and pressed draff liquor (PDL) mix within six falling sequential falling film evaporator bodies and one final forced circulation evaporator body. The plant uses cold water from the CHP cooling tower to condense the evaporated water. Evaporating the water content from the pot ale and PDL produces a concentrated pot ale syrup cattle feed and a liquid process condensate effluent. The condensate from the steam used in the initial heating is returned to the CHP plant for recirculation.

The process plant is designed to accept 66.5t/h of feedstock. It is also designed to accommodate variations in flow and includes feed and product storage to maintain a consistent throughput and enable the plant to accept feed onto site whilst the evaporator plant is undergoing cleaning cycles.

The CHP plant will be in operation for approximately 348 calendar days per year, accounting for one or two periods of planned shutdown of 14 days in the summer months and 3 days in the winter months. Whereas, the process plant will operate for 329 calendar days per year with planned shutdown for 21 days in summer and 15 days in winter (coordinated with local distillery shutdowns). The process plant has an automatic 12 hour cleaning cycle on a weekly schedule.

Given this design, the CHP plant, when supplied with a combination of wet draff and woodchip will produce electrical energy and heat in the form of steam supply to the adjacent process plant at net power production of 6.87MWe at 33kV. Heat supply is 11.91t/h of steam at circa 3.35 barg pressure. The process plant, when supplied with 11.91t/h of steam will process 66.5t/h of pot ale/PDL producing 5.96t/h of pot ale syrup and 60.54t/h of process condensate (further key parameters and performance

guarantees can be found in Appendix 2).

Finally, the design life of the boiler, process plant and steelworks is a minimum of 25 years (Helius CoRDe, 2008).

Drivers. *Describe any external drivers that were important for initiating the case study and for its forward progression eg government mandates, subsidies, tax exemptions, legislation, local pressure groups. Analyse the data to highlight the enabling and constraining factors. Describe how these may have influenced the way in which the project has developed.*
Describe any relevant technology drivers for example, was established technology adopted, was local or internationally-led technology adopted?
Indicate knowledge and attitudes to the concept of an environmental footprint

Andy explained how right from the start of the project there has been a problem because of government investment, subsidies and policy with regards to renewable energy technologies. He highlighted how, when the Labour government was in power between 2000-05 there was no policy at all and they put a stop to the NOFO; *"For a period, right from the start of the project there has been problems in the early 2000s because of government investment and government subsidies in renewable energy, government policy. When the labour government was in 2000 to 2005 there was no policy at all and then they stopped the NOFO and introduced the ROC in 2005, which enabled companies to move forward. But, from 2005, so, 2005 and every 2 years they review it so the policy changes every two or three years."* [130-134]. The introduction of the Renewables Obligation allowed companies to move forward. However, due to the policy being reviewed every two years or so and changes being put in place, this presents problems for projects such as this one. Particularly, Andy emphasised, since most projects take at least five years from start to finish. The ROCs is an example of this. Due to the detrimental effect the adverse changes in government policy and the reduction, for example in allotted ROCs from four to two, and could have upon the project Helius CoRDe had their ROCs guaranteed by means of grandfathering by the government for 20 years to ensure an income stream.

Support. *Describe any support (or lack of support) from Investment Promotion Agencies, export promotion agencies, trade associations, government agencies etc that has had an impact on the sustainability of the case study. Include here any impact that this may have had on the way the business plan evolved.*

Helius CoRDe work closely with the Renewable Energy Association (REA), the renewable energy technology trade association, in order to ensure that government policy is appropriate and that changes are not drastic.

Jobs. *Describe the case study expectations in terms of jobs planned/created, and how far these expectations have been met from initial position. Include details of the percentage of jobs that required training, and percentage of jobs and nature of these jobs given to women. Describe whether the mix of paid and unpaid activities changed after the project began*

Given that part of the reason for selecting the site at Rothes was due to a pre-existing skilled workforce, the development of the CHP plant generated an additional 3 skilled jobs (24 skilled jobs in total, 21 being employed from the existing workforce). During the construction stage of the development man power peaked at approximately 140 on site. Due to the material distribution and delivery additional jobs have been created in this respect (for a full list of the contracts involved refer to Appendix 2).

Business targets and wealth creation. *Describe the case study expectations in terms of*

business targets and wealth creation, and how far these expectations have been met from initial position

The project is yet fully operational, however, the loan will take 12 years to repay and profit will be made following year one.

Training. *Describe how knowledge of the processes involved was gained and then communicated to employees, and whether expert opinions were sought.*

From talking to the Plant Manager at Helius CoRDe, Andrew Wood, he informed me that the company has a training policy whereby all the staff will be trained to obtain an SVQ (Scottish Vocational Qualification), many companies have them, such as EoN who have plant operation NVQ's and they are developing them for this particular site. All the operators will be qualified to a Level 2, Senior Operators at Level 3 and Operational Managers to Level 4 (Plant Manager level), starting September 2013 and will take two years. Andrew explained how the company believes that qualifications are important to investing in people; for the Plant Manager is instils confidence, but even better, the employees feel confident in themselves and this enables a smoother operation.

Local community stakeholder groups.
Describe the stakeholder groups that the case study engaged with, the order of engagement and whether the stakeholder groups changed with time, and if so, explain why.
Describe the methods used to engage with stakeholders and the representatives chosen, for example whether women were actively involved, whether communities were represented by their tribal chief, or by democratically elected leaders etc.
Describe how frequently case study operatives engaged with community stakeholders.
Explain whether there were any conflicts along the way, describe what they were and how they were resolved if at all.
Describe the perceptions of surrounding communities about what the project would bring and what perceptions the stakeholders had over their rights and whether this coincided with current legislation.
Describe whether there were any notable unintended consequences, for example, whether women's access to land water and fuel and household access was affected, and whether long-term income increases were enough to compensate all households for reduced access to land and increased prices

Although there was already plants on the selected site, planning permission still had to be sought. This involved engaging with numerous stakeholders, including SEPA, the Environment Agency, local community and the local Council.

The business plan changed during the process so planning permission had to be sought a second time for the changed layout of the plant. The layout of the plant changed as initially the distillers wanted both their by-products using. Consequently, Helius Energy carried out a 2-year trial into fertiliser processing and production, however, they found that storage and the cost of transfer were problematic. Following a review, it was therefore decided that the soil conditioner plant would be changed to an evaporator, using the existing steam and as such reducing the carbon footprint. This meant that the costs of the project also increased, in order to meet SEPA requirements and compliance for a permit for a Part B Plant.

A condition of the planning was that the 1.5kW of waste heat the plant generates be fed into the district heat system, however, this changed once they decided to put the evaporator in. The company is in talks with Moray Council to feed it to the local school. Andy advised that they are prepared to provide the school with the heat for free, but the pipes and network is expensive. This is still, however, on the cards for the future.

The company also engaged with Scottish Heritage as there were badger sets in the area and they were required to put up fences in order to protect them. Having carried out the

suggested measures, Helius CoRDe does not need to monitor this into the future.

Finally, as a requirement of the planning process, Helius engaged with the local community throughout the process. They held forums for stakeholders to engage and ask any questions or raise concerns which they may have. This was relatively straightforward as there is only a small local community and as there has been a plant on site since 1904 there is already a forum set up which is held on a regular basis for Q&A and Helius joined on to this. They also advertised in the local newspaper and one of the Directors, Frank Burns, had an open-door policy in this respect.

However, no opposition was received and only one person came forward for additional information.

Andrew explained that this is the industry for the area and a means of employment and therefore the community are happy for the plant to go ahead:

> *"There is an existing community with the existing CoRDe factory there is an existing community meeting, that takes place and there is a local newspaper, which we contribute to, we write and tell people about what is going on, but generally this community here is so small. Rothes is such a small town that you tell the post office and everybody will know [laughter].*
> *Our cleaner lives over the road and she passes the messages on [laughter]. So there is no secrets here."* [511-516]

In addition, the company has brought other additional benefits to the area such as the extended employment offered as well as, for example, superfast broadband.

Impact on agricultural practice
Describe whether the availability and type of food on local markets changed after the project began and whether there was any impact on localised supply of or demand for food and fuel and if there were any credibly attributable impacts on prices
Describe whether there were any changes in land use as a result of e.g. new biomass farms being established.

Andrew explained how there was no impact upon the agricultural landscape as there is already evaporators on the site. In fact the new plant will generate a net saving of 64 compared to a coal powered power plant of the same size.

The plant has enabled a new woodchip supplier distribution depot to be sited nearby following the contract secured from the plant and as a consequence several jobs have been created. Due to the deliveries already being made to the existing plant there is no additional impact upon the environment as a consequence, and ultimately the local community view it as a positive thing.

Future growth plans and recommendations. *Describe what the future growth plans of case study are, if any, and what the perceived opportunities and threats might be for future growth.*

Andrew explained that there is little space on the site and that that is something that they would change if they could. New land will be freed up once the two existing plants are mothballed, but as yet they do not know when this will be. Consequently, when this takes place they would like to generate storage for their woodchip so if any complications arise as they use as delivered they could still run the plant.

The plant are also looking into providing the local school with their 1.5MW of waste heat which is presently not utilised, however, although they are prepared to donate this, the cost of the piping is proving a hurdle. In the future Helius CoRDe will try and secure funding for this.

For all of the questions try to tease out as much additional information as you can. Ask "why"?

1. Date of Interview:	**28th February 2013**
1.1 Interviewer's name:	Katie Thompson
1.2 Respondent's name:	Andrew Wood
1.3 Position within organisation	Plant Manager
1.4 Position/role within a Biofuel Supply chain	Plant Manager
1.5 Name of enterprise / project	Helius CoRDe
1.6 Location, country	Rothes, Scotland

Appendix 1: Helius CoRDe Contracts

Key Contracts to the value of £44million were provided in respect of: -

Company	Service
Fichtner Consulting Engineers Ltd	Engineering employers representative to assist Helius with the delivery of the project
Aalborg Energie Technik A/S (AET)	Design, supply, erection and commissioning of the Biomass CHP plant.
Robertson Northern Ltd	Undertake civil works, provide the underlying infrastructure for the plant and associated equipment and Principal Contractors role for the duration of the project
Wellman Process Engineering Ltd	Provide evaporation equipment for the Pot Ale Syrup

Appendix 2: Helius CoRDe CHP Key Plant Parameters and Performance Guarantees

Parameter	Value
OUTPUT	
CHP Gross Output [MWe]	8.32
CHP Net Output [MWe]	6.92
Parasitics [MWe] (estimated)	1.4
Steam Output [MW]	42.1
Steam to Process [t/h at 3.35barg]	11.91
Annual Availability [%]	90.6
Bottom Ash (dry) [Kg/h]	70
Fly Ash [Kg/h]	140
INPUT	
Fuel Consumption	
Wood [t/h] (at 50% moisture)	7.2
Distillers Grains Dry [t/h]	3.95
Wood, NCV [MW]	16.1
DG, NCV [MW] (at 20% moisture)	18
Total Heat Input NCV [MW]	34.1
Efficiency	
Boiler[%] (on ENCV)	91.8%
Load Range	50-100%
Plant Electrical Efficiency (on ENCV)	20.3%
Overall Plant Efficiency on (ENCV)	44.0%
Steam Parameter	
Temperature [C]	452
Pressure [Bar]	82
Flow [t/h]	42.1
Guarantees	
CHP Plant Net Output	6.87MWe
Max woodchip consumption at guarantee point	7.2t/h
Turndown Ratio	50-100% (up to 25% if manual)
Noise at 1m	80 dB(A)
Availability [hours/year]	7934
Emission Guarantees [mg/m3, 11% O2]	
CO	200
Dust	20
HCI	15
NOx	200
SOx	133
VOC	15
Project Delivery [weeks]	108
Boiler	
Type	Travelling Grate
Height [m]	17.3
Depth [m]	9.5
Width [m]	3.24
Volume [m^3]	468

Turbine	
Type	Condensing turbine with controlled extraction (MAN Turbo, MARC 2)
Emissions Control System	
Dust Control	Bag Filters
Nox Reduction (option)	SNCR (UREA)
Acid Gas	NaOH Injection