MOSTEX
Global Solutions

Biomass Feedstocks Innovation Programme

Phase 1 Final Report (Redacted)

February 2022

Prepared For:

The Department of Business, Energy & Industrial Strategy

MOSTEX

Mostex General Notes

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1 Project Objectives

The BEIS £1bn Net Zero Innovation Portfolio is part of the government's drive to net zero. Within the Net Zero Innovation Portfolio, the Biomass Feedstocks Innovation Programme seeks to:

- Remove barriers to biomass feedstocks growth
- Provide support for the commercialisation of innovative clean energy
- Increase biomass productivity

The feedstocks contemplated include perennial energy crops, agri-waste and forest residuals.

Mostex has developed a process and technology design that can address all three of the above areas and can be applied to a wide variety of feedstocks. During Phase 1, we have tested our markets and defined the challenges that exist and need to be solved through innovation.

The initial project is based upon a host site in Strathy Forest, northern Scotland. The landowner needs to clear fell 1,500 hectares and return the land to peat bog. This forestry has been poorly managed for decades and cannot all be economically harvested. The fragile nature of the majority of the ground means footprint must be minimised.

Our research has led to the conclusion that supplying whole-tree chips to an in-woods processing plant with the right plant and machinery will reduce the cost of raw material by 12.5%, equivalent to a saving of [redacted] p.a. on the Strathy site when compared to conventional harvesting practices.

In order to deliver these cost savings, a new type of harvester will be required. One that minimises footprint and movements in the forest, but which also has an economically viable load capacity.

The obvious market for the processing plant is the energy pellets sector. This requires the whole-tree chips to be densified, however processing these chips presents its own challenge as they contain levels of ash, chlorides, sulphur and nitrogen that are too high for this purpose.

Mostex has already achieved proof of concept regarding the use of steam and water to clean up not just wood chips, but also the various feedstocks detailed above. Now the challenge is to design and demonstrate technology that will deliver the process but also be capable of being manufactured on a commercial scale.

The result of Phase 1 is that the Mostex Reactor Assembly (MRA) has been designed, built and tested with positive results. This innovation, which is patentable, will pave the way for upscaling in Phase 2.

Mostex has a long term ambition to produce 1m tonnes of energy pellets from a range of UK-sourced feedstocks that can replace 10% of existing wood pellet imports. This would not only generate many jobs within the UK but would also provide improved fuel security and significant reductions in GHG emissions, not least by avoiding long-distance shipping.

2 Innovations

Mostex has been working on two innovations during Phase 1: the Harvester and the MRA.

2.1 Harvester

This innovation is aimed at the challenge of harvesting and extracting forestry that is not of sufficient quality to merit conventional treatment ("semi- "and/or "non-commercial"). In addition, the pilot site at Strathy has a requirement to be remediated back to its original peatbog – this places a premium on minimising the number of machine movements within the forest.

Whilst designing the Harvester we have taken into consideration the poor condition of the forestry, the soft underlying ground conditions, haulage from forest to plant and whether to deliver chip or whole trees to the plant. Other key considerations have been our CO_2 emissions, the economic viability in comparison to pre-existing technologies and the desire for as little environmental impact as possible.

Our conclusion is that whole tree harvesting followed by chipping/milling at the in-forest processing plant would be the most cost effective and environmentally beneficial option for the management of semi-commercial timber. Delivering whole stems to the plant will increase output at the site by at least 20% and the ability to use the 'total fibre' will also have an enormous benefit on the economics.

Having examined the existing harvesting options currently available on the market, we have reached our conclusion based on innovation, impact, budget, resource and deliverability. We have identified that the forwarder feller collector innovation would be the best way forward and could offer savings of [redacted] on the pilot forest alone. If applied to the wider UK forest areas, [redacted] of identified savings could be achieved annually.

Alongside developing the Harvester in Phase 2, Mostex will carry out further evaluations of the Klingmill size reduction technology within the processing plant activities.

The tables below summarise the economics of the different commercial standards and the proposed solutions to take the biomass from a standing tree to the intake feed of the processing plant.

Diagrams of the Mostex solutions are in included in Appendix B.

	[redacted]			
	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
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	[redacted]				
	[redacted]	[redacted]			
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[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

A key challenge will be ensuring that the additions of the harvesting arm and the size increase of the base machine do not increase ground pressure beyond the weight-bearing limits of severely waterlogged and very soft areas of ground. However, an expected ground pressure of around 5-6psi when carrying a load of 5 tonnes is still only just over half of the 8psi ground pressure exerted by a typical human.

For haulage, an off-road hauler chassis presents the best option. Good road speed, very good off-road capability, high power and long body options. Wide tyres up to 1m give a very gentle footprint in terms ofroad erosion. This conversion is relatively straightforward with high engine and hydraulic output and was therefore not targeted as a priority in Phase 1 but will be dealt with in Phase 2.

[redacted]			
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]

From investigation with local contractors and purchasers, landowners would incur a loss of [redacted]/tonne if the site was conventionally harvested. This equates to an expected loss of [redacted]m over the site as a whole.

If Mostex were to whole tree harvest using current commercial techniques and then process to pellet on site, the economics would be transformed to a profit of [redacted]m; a gain of more than [redacted]m on the site ([redacted]/tonne).

In the optimum Mostex case whereby the new harvesting techniques were also employed then the landowner would net an additional [redacted]m delivering a potential combined gain of close to [redacted]m or almost [redacted]/tonne.

2.2 Mostex Reactor Assembly

In order to process whole tree chips (and other biomass such as miscanthus, SRC willow and cereal straw), Mostex has already demonstrated that the process of applying steam and water in separate phases has the effect of cleaning up the feedstock and bringing it into specification for use as an energy pellet in power generation. The challenge for the Phase 1 project was to design a system that could deliver the process, handle low-bulk density material and have the potential to demonstrate scale in Phase 2. To our knowledge, no other companies are applying steam in this way to alternative biomass feedstocks and a patent application is being prepared.

The Mostex Reactor Assembly [redacted] is not an overly complicated design, however it does contain some innovative and unique aspects that are expected to be the subject of additional patents as "daughter" applications to the system as a whole.

The abrasive nature of many of the feedstocks that may be processed through the system has demanded the use of materials with high tolerances in fabrication. This, along with the requirement to meet the extremely demanding Pressure Equipment Directive (PED 2014/68/EU), made the manufacturing challenging. [redacted]

[redacted]

The MRA has been delivered to site (right) and we have commenced processing various biomass samples. Test runs to date have confirmed our design principles.

[redacted]

- [redacted]
- [redacted]
- [redacted]
- [redacted]

[redacted]

The photos in Appendix C show the reactor being loaded and what the woodchips look like pre- and post-steam explosion. There are three signs that the steam explosion has worked:

- The material colour has darkened considerably [redacted]
- The fibre length has shortened [redacted]
- The exploded material gives off a strong smell of sugar, [redacted]

All three were present during the tests.

Following on from the successful completion of Phase 1, Mostex will use the core design and technological learnings to upscale the MRA [redacted]

[redacted]

Key learnings from Phase 1 have been around supply chain, value chain, regulatory change and design validation which will enable us to take into account the rising prices of raw materials, time delays and global supply shortages in Phase 2.

To support the pilot plant, we will upgrade and automate the test facilities to enable multiple feedstocks, including many of the projects in the BFIP, to be processed and tested. Over the course of Phase 2, we would expect to interact with the successful Lot 2 multi-site demonstrator and potentially move our test reactor to their site(s) to carry out this processing.

3 Product

Virtually all pellets produced today are known as white wood pellets. Typically made from softwoods (pine or spruce), using either de-limbed stemwood or residuals from sawmills, white pellets suffer from several design flaws:

- Water absorption (fluffing up and losing all shape) demands specialist transportation and storage using bespoke constructed infrastructure.
- Prone to fines (dust) resulting in 10-15% losses and fire hazard (in 2020 a ship unloaded in the UK with more than 20% fines).
- Specialist transportation and storage is required using specially constructed watertight and dust suppressing infrastructure to avoid pellet degradation and/or dust explosion.
- Higher storage costs making them uneconomic without subsidy for domestic or light industrial use.

3.1 Mostex Pellet

[redacted] The Mostex Pellet delivers:

- A calorific value in excess of 19 GJ/tonne with a higher bulk density of 750-800 Kg/m^3; (white pellets are typically 16/17 GJ/tonne and 600-650 Kg/m^3).
- Ash content below 1%.
- Increased ash deformation temperature (any silica left in raw material will not melt in the boilers to cause slagging).
- Reduction in Nitrogen and Sulphur oxides (NOx and SOx).
- A hydrophobic pellet, allowing transportation in standard carriers and no storage requirements.
- Higher durability so less fines (no risk of explosion if stored indoors).
- No off-gassing as volatiles are removed as part of the steam explosion process.

The table below compares whole-tree chips from Thetford Forest that have been steam exploded with the current industrial wood pellet standard (EN-B) also known as I2. The chips used here are more or less identical from those in Strathy Forest.

Analysis	Method	Unit	En-B	Woodchip
Ash content at 550 C	SS-EN 14775	% of dry matter	3.00	0.90
Net Calorific Value	SS-EN 14919	MJ/Kg dry matter	16.00	19.90
Sulphur at 1050 C	EN ISO 16994	% of dry matter	0.04	0.02
Nitrogen at 1050 C	EN ISO 16948	% of dry matter	1.00	0.20
Chlorine	SS 187154	% of dry matter	0.03	0.01
Initial Deformation Temp	SIS-CEN/TS 15370	^{o}C	1100	1150

These results demonstrate that the Mostex Pellet is ideally positioned to displace lower value imported white pellets. Additional analysis previously carried out by Mostex on other feedstocks is contained in Appendix E.

4 Market

Mostex's initial project is to build an in-forest commercial plant based in Strathy to produce 45,000 tonnes of pellets p.a. As shown in the table below, installed demand within Scotland alone is in excess of 1.6m dry tonnes so affording a viable market for local sales.

Wood fuel currently meets 3% of Scotland's total energy demand, providing 11% of Scotland's renewable energy, broken down into the categories shown in the table below:

Category of Use	No. of Installations	MWh/y Generated	Wood Fuel Used Dry t/y
Domestic wood heating	120,974	549,766	230,069
Heat under 1,000kW	3,216	1,284,905	324,606
Heat over 1,000kW	30	1,904,812	619,756
Electricity	10	1,098,821	495,821
Totals	**124,230**	**4,838,304**	**1,670,252**

(Reheat UK, Review of Scottish Wood Fuel Industry 2021)

Aside from the end users (Appendix F), the wood fuel business in Scotland encompasses a wide range of categories including self-suppliers of wood fuel, firewood suppliers, pellet agents and wood fuel haulage, sawmills, recycling companies, wood chip suppliers, pellet mills, and installers.

Within the UK the solid biomass electricity mix is currently dominated by wood pellets produced from forestry residues and lower grade pulpwood, most of which are imported from North America and Europe (10m metric tonnes were imported in 2020 – Appendix G). The transportation of these pellets, mostly using oil-fuelled shipping, results in high emissions that could be negated by substituting imported biomass with locally grown and processed alternatives.

The UK's grid is currently supported by 2,300 MWs of generation from 100% pellet fuel. The figures inAppendix H show the variability and intermittency provided by solar, wind and natural gas whilst thebaseload provided by biomass power suppliers and nuclear remains consistent, taking up any slack in demand and supply.

It is estimated that in the UK there is more than 500,000 hectares of under-managed commercial forestry that could provide an additional 1.3m tonnes of biomass per annum. This would be sufficient to supply ten Mostex pellet plants, each producing 45-50,000 tonnes of pellets, generating over £5m revenue annually (pricing based on long term industrial white pellets contracts, Futuremetrics LLC). Access to this forestry, using Mostex's modular design which enables processing to be carried in even stranded acreage, will go a long way towards meeting Mostex's long term target of 1,000,000 tonnes of UK-produced pellets.

Perennial energy crops - predominantly SRC and Miscanthus - have been part of the UK's biomass production since the mid-1990's. As of 2020, the crop area was 10,000 hectares producing around 100,000 dry tonnes per annum of raw material. The Climate Change Committee (CCC) suggest that over 700,000Ha of land could be dedicated to energy crop. Defra's land use net zero programme will help determine the potential realisable scale and ability to deliver GHG savings in a landscape optimised for multiple benefits.

Agricultural crop residues are another significant but underexploited biomass resource in energy terms. Based on their 2020 Sustainable Bioenergy Feedstocks Feasibility Study report, Ricardo estimate an average annual collectible crop reside of around 11m tonnes/annum of which just over 3m tonnes/annum are expected to be available for bioenergy production.

5 Phase 2 Project Plan: Project Timelines Gantt and Milestones

The Mostex project timeline in the Gantt chart (Appendix I) provides an overview of the entire Phase 2 project from start to finish. This designates Work Package owners and Work Task elements that are assigned to third parties.

Mostex directors have an extensive range of experience both in the delivery of public funded R&D projects and in development of commercial businesses. The project team will consist of the following key people and roles:

5.1 Project Management

- **Project Director - Mark Paulson:** Mark has been in the agricultural energy sector from the mid-1990s in perennial energy crop production for power generation. This expanded into commercial interest in biomass processing, anaerobic digestion and solar which continues today. Mark has led and participated in R&D projects from the days of ETSU (DTI), in EU FP7 funded activities through to Innovate. Key projects delivered have been in Energy Crop Production, Energy Crop Harvesting Machinery Development, Biomass Production and Logistics, Energy Conversion /Waste Energy Capture and Energy storage. Mark brings both technical expertise and project delivery experience to lead this project.

- **Financial Director - Alex Pegley:** Alex is an experienced investment professional. Amongst a range of investments Alex has since the mid-2000's been directly involved in developing, financing and operating a number of businesses in biomass production and processing. Alex will be responsible for ensuring financial control, corporate responsibility and bringing commercial management skills to the project.

- **Project Manager – to be recruited:** At the point of confirmation of the Phase 2 project and completion of contracts, Mostex will recruit a dedicated project manager to run the day to day delivery of the project.

5.2 Senior Engineers

- **Wayne Scurrah:** Wayne is an Associate Member of the Institute of Chartered Foresters who has operated in the contracting, management, and advisory sectors of the industry. Wayne successfully developed his own contracting business to an exit in 2016 and has since focussed on management and development opportunities. Wayne brings technical forestry skills along with direct operational experience to lead on the harvesting system development in the project.

- **Paul Atherton:** Paul is by background an electro-mechanical design engineer who has operated in both global engineering and aerospace businesses and innovative start-up SME's. As well as the business skills from operating at senior level in large corporates (including with Alex), Paul brings extensive technical skills to the group, particularly around core process plant design and optimisation. Paul will lead on the Mostex Reactor Assembly in the project.

- **John Hamlett:** John has been involved in the forestry industry "man & boy" from operating machinery through to operations management in very large-scale corporate forestry business in South America and Africa. John was previously responsible for developing sales of the Zilkha Biomass steam exploded pellet in Europe. John will contribute to both the harvesting system and marketing development in the project.

5.3 Commercial Research

To build on the Phase 1 identification of biomass resources and locations Mostex will appoint a dedicated person to further qualify and quantify these potential opportunities to increase UK biomass supply.

5.4 Operational Engineers

In the later stages of the project, once construction of the pilot plant has been completed, there will be a requirement for operators to run the plant during its commercial testing. Two operators will be recruited towards the latter stages of the plant construction to run the pilot plant.

5.5 Project Administration

- **Administrator - Peta Pegley:** Peta is a former HR manager at a City investment bank with marketing and PR experience, before moving to work in a leading Executive Search firm. Peta will be involved in the administration, documentation and delivery of all necessary support functions in the project.

The group all have experience of developing new business streams and opportunities from concept to commercial operation. These specific skills and relationships will be applied to the second phase of the project in developing the commercial exploitation strategy and actions, then in due course delivering these.

In addition to in-house expertise Mostex has identified a number of key areas which require skills to be contracted-in for specific tasks.

5.6 Core Sub-Contractors

- **Specialist Fabrications (Mostex Reactor Assembly) - AJ Metal Products Ltd:** A J Metal Products Ltd is an internationally recognised manufacturer of high integrity pressure vessels, air receivers, skid packages and welded fabrications. They are further strengthened by their sister company Victoria Drop Forgings Co. Ltd to provide a combined capability of CNC machining, forgings & pressings in various materials, 3D Design, 3D printing and general fabrication. Paul leads this relationship for Mostex.

- **Forest Harvesting Machinery Design – Howie Forestry Solutions:** Howie are experienced in converting agricultural and forest machines for work in the sector so have the capability to fabricate our solution from the core component parts purchased. Identified key component suppliers are John Deere (harvester base), Prinoth (LGP systems), Cranab & Bracke (harvesting crane/head) and ABAB (collector) who will feed in to Howie for the creation of the prototype unit.

- **Forest Harvesting Contractors –** We are in discussions with Robinsons Timber and RG Blakey Ltd. Both are harvesting contractors running multiple crews and can field test the developed forwarder collector.

- **Water Treatment - MSE Systems:** MSE Systems is a specialist wastewater treatment contractor. Active in food processing, agriculture, and energy, MSE design and deliver machinery and solutions to treat a range of effluent streams. MSE will provide input to the treatment of post wash water to ensure clean up prior to discharge. Mark Paulson has an ongoing relationship with MSE dealing with solutions in the treatment of liquid digestate from Anaerobic Digestion.

- **Materials Analysis - Alfred H Knight Energy Services:** Alfred H Knight are the leading provider of inspection and testing for the metals, minerals, and solid fuels industry. Operating from a network of accredited laboratories they deliver independent analysis of these materials and are approved by major energy customers. Mostex has previously used Knight's services for testing raw and treated biomass materials and they will provide these services to the project. Alex leads this relationship.

- **Combustion Analysis – BioC:** Alf Malmgren at BioC has been delivering technical combustion consultancy on solid fuels since the early 1980's, including to a number of the UK's large biomass plants and conversions. Alf brings unrivalled practical and commercially focussed technical expertise and knowledge in this field. Mostex has worked with Alf to analyse raw and treated biomass samples and analysis for customers. John leads this relationship.

5.7 Project Hosts and Associates

- **Sutton Grange:** Sutton Grange is an agricultural and energy site that is well known for commercial biomass and Anaerobic Digestion, and which has hosted the test rig in Phase 1. This role will be continued in Phase 2 with Sutton Grange supplying various support services in addition to being the location for testing of the processing plant.

- **SSE plc:** SSE is a long-term contact having worked on various biomass fuel initiatives with two of Mostex's directors. SSE are a strong supporter of this initiative as evidenced in the attached letter in Appendix J that was supplied for Phase 1. SSE will provide access and data for the project site at Strathy as the example case for Phase 1 and will be a future prospective client beyond Phase 2 of the project.

6 Risks and Risk Management

A risk register (Appendix K) will be implemented and managed by the project manager. The risk register will be closely aligned with the reporting plans to ensure that all potential risks are noted, tracked and mitigated as appropriate.

6.1 Quality Assurance – Quality Management Systems (QMS)

Quality management is critical in ensuring that products of the nature of a high-pressure steam reactor and high-intensity forestry clearing, and processing vehicles and equipment are able to undertake its operation repeatedly, robustly, and safely. Accordingly, as in Phase 1, we will only be partnering with manufacturers who - in the case of the reactor - are certified to fabricate pressure vessels using high-quality materials that meet the PED 2014/68/EU accreditation.

Additionally, the following elements and systems will be implemented to ensure successful completion:

- **Project Management System:** Mostex will use PRINCE2 methodologies to manage the interaction with the contractor. The contractor will use their own internationally recognised methodology.
- **Standards**: The contractor will have ISO9001, ISO14001 and ISO 45001 certification and be managed by an international rating agency.
- **Quality Assurance Oversight (QA):** During the manufacturing process, QA will be undertaken by both Mostex and the contractor manufacturer.
- **Quality Assurance Responsibility** - external independent assessment of the end product will be undertaken. In the case of the steam reactor this will be by the specialist PED, CE, and Zurich rating assessors.
- **Quality Assurance Certification and Documentation** - the contractor manufacturer will provide all certificates of compliance with the stipulated regulations. Additionally, the contractor will also supply warranty documentation and relevant supply guarantees from any 3rd party suppliers. Furthermore, all project documentation will be signed off by both quality managers and both project managers.

6.2 Project Controls and Governance

Mostex will use a combination of tools, strategies, business knowhow as well as learnings and experience ofsuccessfully overseeing previous projects to manage Phase 2 from origination through to completion. In particular, PRINCE2 methodologies and frameworks will be employed to manage the project interaction and close-coupled collaborative reporting with the various contractors. The contractor will use their own internationally recognised methodology and frameworks standards to undertake and manage their tasks.

6.2.1 Control - Project Validation

In particular, all aspects of the Phase 2 project will conform to the Mostex standard stakeholder validation due-diligence criteria prior to commencement, these ensure that the project has passed the threshold as being:

- **Worthwhile:** The project is mutually beneficial to both Mostex and prospective customers.
- **Viable**: The project is technically doable and that Mostex, its partners and the customer have sufficient resources and expertise to undertake the task.
- **Affordable:** The project is within the scope of customer affordability and budget.
- **Good Value for Money**: The project is perceived as being a worthwhile investment from both Mostex and the customer's perspective.
- **Planned and Controlled**: The project is able to be properly resourced with skilled personnel from Mostex, its partners and the customer and is able to deliver its core objectives to budget and plan.
- **Within Tolerances for Acceptable Risk**: A full risk analysis has been undertaken to ensure that a successful outcome is to be expected.

6.2.2 Control - Project Reporting

Mostex's standard reporting fulfils the need to provide information on the project management process such that data is taken from where it's generated and delivered to where it's interpreted and applied. Mostex's reporting provides a high-level overview that offers the critical data the project generates in a standard reporting format; the project management team will provide updates on continuity using a combination of the following formats:

- **Status Reports**: Weekly, monthly, and quarterly updates on all aspects of the project.
- **Risk Reports**: Monthly updates but with ad-hoc dynamic intervention and mitigation capability.
- **Board/Executive Reports**: Quarterly updates and status synopsis and a full annual review.
- **Resource Reports**: Weekly HR review and monthly advanced planning.
- **Variance Reports**: Weekly updates linked to Risk Report.

6.2.3 Governance Framework

For Mostex, the purpose of project governance is to ensure that its decision-making framework is logical, robust, and repeatable to govern any type of project or programme of work and is independent of the underlying usage of a particular type of project methodology. In this way, Mostex is able to deliver a structured approach for conducting both its business-as-usual activities and its business change, or project-activities.

The Mostex framework is structured around eight core pillars of governance:

- **Initial and Continuing Justification of the Project**: A project proposal must pass the validation due- diligence to be considered as a viable project. The project must continue to pass the standard financial, technical and scope validation thresholds during its lifecycle.

- **Establishing an Appropriate Management Organisation**: Mostex has sufficient skilled resources on-call to be able to assemble a cohort that is capable of supporting any customer originated project.

- **Establishing a Framework for Decision-Making (Roles/Responsibilities/Authorities)**: Mostex deploys a project-specific management team that may be led/directed by different managers dependent upon their expertise. This is closely aligned with a prospective customer's resources to ensure continuity of support and to further facilitate peer-reviewed decision making by stakeholders.

- **Delivering Comprehensively Prepared Plans and Ensure They Are Updated as Required** – By using proven repeatable methodologies and frameworks such as Prince 2, Mostex are able to apply consistent and reviews repeatedly regardless of the manager that is leading the programme of work.

- **Implementing a Quality Management Strategy**: Mostex is seeking to attain ISO9001 certification in due course. In the meantime, Mostex is using the framework to organise its own quality systems such that processes and operations can be evidenced when accreditation is sought.

- **Implementing and Operating a Project Monitoring and Control Regime**: Mostex uses the reports as referenced previously to closely monitor all project activities.

- **Managing Uncertainties (SWOT)**: The Mostex management team undertakes a quarterly review of its business to ensure that it is adequately monitoring prospective issues, is able to mitigate against potential threats and further is able to take advantage of opportunities.

- **Managing Problems and Changes**: The Mostex management team has a culture of inclusivity and diversity that actively promotes open dialogue, without fear of suppression. Through open discussion, we are able to manage problems and change in a more constructive way that enables speedy resolution of issues.

7 Commercialisation

The need to successfully commercialise the Mostex technology and process has been the driving forcebehind the approach to Phase 1 and will continue through Phase 2.

A common theme has emerged in discussions with potential suppliers, project partners and end-users which is, "Show us that you can make an in-specification product and we are interested in working with you."

Being successful in Phase 1 of the BFIP programme and being able to move from the lab and drawing board to a test scale with a real working micro plant has helped us move along this path, demonstrating our design philosophy works and produces an in-specification product.

With our technology proven in Phase 1, Phase 2 is all about production at scale.

The forestry sector will not engage fully until a real world machine that they can "kick the tyres" is shown tothem. Building this first prototype, testing and operating it with an experienced contractor will both confirm the design success, iron out the operational gremlins and demonstrate the machine felling and harvesting trees in the forest.

Building and operating a commercial-size [redacted] reactor assembly will deliver an hourly throughput of 5 dry tonnes. This will support production runs of up to 500 tonnes for testing in various biomass facilities. These burn tests are essential to demonstrate that quality and specification can be maintained over time as well as confirming operating costs.

The Phase 1 test rig is key to identifying the full range of potential biomass sources and in setting up and then optimising the process parameters for them. This unit and its support equipment [redacted] will be transferred into a trailer/container so that it can be used at demonstration events organised by BEIS and the successful Lot 2 group.

7.1 Mostex Products

The Mostex system [redacted] results in two output streams: solid biomass for processing to fuel and a liquid stream.

7.2 Solid Biomass

This is the core product from the process and targets the energy market. [redacted] it can be used as a direct fuel for use in grate boilers, but in most cases will be dried to 85-90% dry matter and made into briquettes or pellets. All of these processes through to finished fuels will be in containerised units that form the on-site processing plant. These will be demonstrated at the pilot plant site.

7.3 Liquid Stream

Alongside the solid biomass there are liquid co-product streams [redacted]. Dependent on the material being processed [redacted] these can have significant levels of sugars as well as other potentially useful elements. Initially, the water will be filtered and recycled, with any solid matter disposed to land using standard water treatment processes such as Dissolved Air Flotation plants and aeration.

We know that there is a significant Chemical Oxygen Demand loading in this water and so it has potential application as a feedstock for anaerobic digestion, and where sugars are present in reasonable levels, there is the potential to concentrate this further for use as a molasses replacement in animal feed. During Phase 2 we will explore applications for this as a base material for algae production and in fertigation for energy crops alongside relevant Phase 2 projects.

7.4 Market Strategy

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

7.5 Manufacturing

The process of selecting our engineering supplier for Phase 1 was challenging, mainly due to the specific pressure requirements and the decline of the UK manufacturing sector. This was then further exacerbated bythe challenges of covid both for the business themselves, but also in their supply chains. Changing regulations and import requirements from Brexit also did timelines and availability no favours either.

We have established a good working relationship with a West Midlands manufacturer - [redacted] They are an internationally recognised manufacturer of high integrity pressure vessels. They have been excellent in working with us to take our design and turn it into a delivered test unit within an exceptionally tight timetable.

We aim to contract with them to deliver the Phase 2 [redacted] pilot reactor however they have advised that in the longer term, manufacturing multiple repeat commercial reactors is not their core business and nor is it an area that they currently wish to explore.

Through previous projects and work within the wood pellet industry we have good links to equipment manufacturers and suppliers. As the global market for traditional "white wood" pellet plants declines, drivenby higher costs of wood and increasing political and environmental criticism, we believe that this sector will be looking for new market opportunities. [redacted]

7.6 Target Markets

Initial targets will be in the UK primarily from existing biomass suppliers of raw material [redacted]

[redacted]

Following on from the above, we will look to build on further UK opportunities in new and emerging biomass sources: hemp, heather/bracken and others that come forward at scale. Alongside this we will take the potential export opportunities identified and identify partner organisations in these areas that we can work with on a supplier/licence basis to deliver technology solutions.

7.7 Draft Rollout Plan

2022-2024	BFIP Phase 2
2025	Strathy (45k forestry)
2026	UK plant (80k forestry) [redacted]
2028	2 x UK plants (80k each forestry) & 1 x UK plant (50k straw/miscanthus/SRC)
2030	2 x UK plants (80k each forestry), 2 x UK Plants (80k straw/miscanthus) [redacted]

[redacted]

8 Financial

8.1 Economics

For sites such as the Strathy Forest that are poor in their biomass production and remote from markets, the base case is not economically viable. Research carried out with local contractors and purchasers predict a loss of [redacted] across the whole site.

By comparison, were Mostex to whole-tree harvest using current commercial techniques and then process to pellet on site, a profit of [redacted] could be achieved and if the proposed new harvester is employed as well, profitability would rise to [redacted].

At these economic levels, the effect on biomass supply is transformative, with landowners now able to commit to harvesting their forests and bring significant volumes of UK biomass to the market. In deliverable 2.2, Mostex identified [redacted] of this type of forestry that could deliver [redacted] tonnes/annum of biomass.

8.2 CO_2 Emissions

A conventional approach to the site would be to harvest roundwood as one stream, then recover brash and finally where harvesting was totally uneconomic, to mulch the crop into the ground. Assuming the roundwood and brash would be utilised for energy production, this gives a GHG footprint of 105.8 $kgCO_2$/Dry Tonne

We calculate the Mostex equivalent at 95.3 $kgCO_2$/Dry tonne, so a modest improvement against the conventional approach (see Appendix L).

BUT the GHG footprint of imported white pellets for energy generation from the South East USA is currently 50 $kgCO_2/GJe$. By comparison, the Mostex pellets would only be 13.34 $kgCO_2/GJe$. This saving of nearly three- quarters provides strong support for our long term aim of displacing 10% of all wood pellet imports.

8.3 Financial Model

The financial highlights of the Strathy project are shown in the table below. The full model and its main underlying assumptions are contained in Appendix M.

[redacted]	
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]

9 Financial

Building on the work in Phase 1 and delivering a successful Phase 2 project will have a significant impact in bringing forward innovative solutions that deliver significant volumes of UK biomass to the market. Our research indicates there are 500,000 ha of suitable UK forest that can deliver 1.3m tonnes/annum of new biomass supply.

If the CCC target of expansion of energy crop production to over 700,000 ha by 2050 is validated by Defra's land use net zero programme and adopted into policy, Mostex processing solutions could add value and expand market opportunities to the 7.5m tonnes/annum of expected biomass. In the shorter term, Mostex technology can be applied to process some of the 3m tonnes/annum that Ricardo identified in their 2020 Sustainable Bioenergy Feedstocks Feasibility Study project as available agricultural straw for bioenergy.

Beyond this, there are export opportunities for the technology in processing agricultural co-products such as bagasse, rice straw and palm products to improve combustion quality, storage, logistics and enable wider and more efficient use of these raw materials.

Our Phase 2 project will address two key requirements and delivers two new innovations.

- Our design for a single feller/collector that will deliver whole trees to an in-woods pre-processing plant will turn uneconomic land into viable and valuable assets.
- The application of [redacted] our patentable Mostex reactor will clean the chips of undesirable chemical elements and deliver a clean, cheap, sustainable fuel with reduced GHG emissions.

The funding required to deliver Phase 2 [redacted]

This funding is not available commercially at this stage as investors from both within the industry and externally require demonstration and proof at pilot plant scale before they will commit funds. Therefore, the BEIS programme and award is key to being able to unlock this.

Following completion of the project in late 2024 we expect to be in a position to rapidly roll out commercial projects. Through the following five years we believe we can close project opportunities for five UK forestry based plants and three based on energy crops and agricultural straw. These will deliver over 600,000 tonnes of pellets to UK users, taking Mostex a long way towards our ultimate aim of displacing 1m tonnes of imported wood pellets.

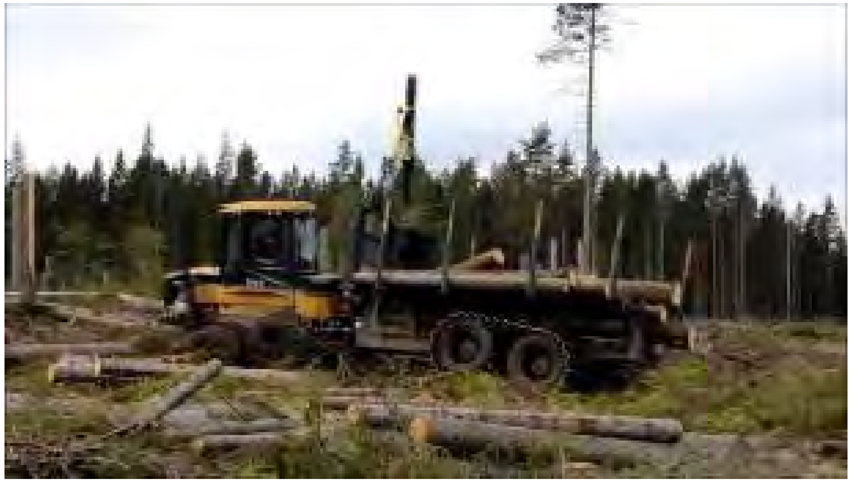
We will also target [redacted] export opportunities [redacted] Mostex will at this point be financially self-sustaining through development fees and technology licence income.

The award of this crucial pre-commercial funding by BEIS will deliver significant UK biomass volumes and put the UK green industry at the forefront of delivering the technology required to transform global agricultural co-products into usable fuels.

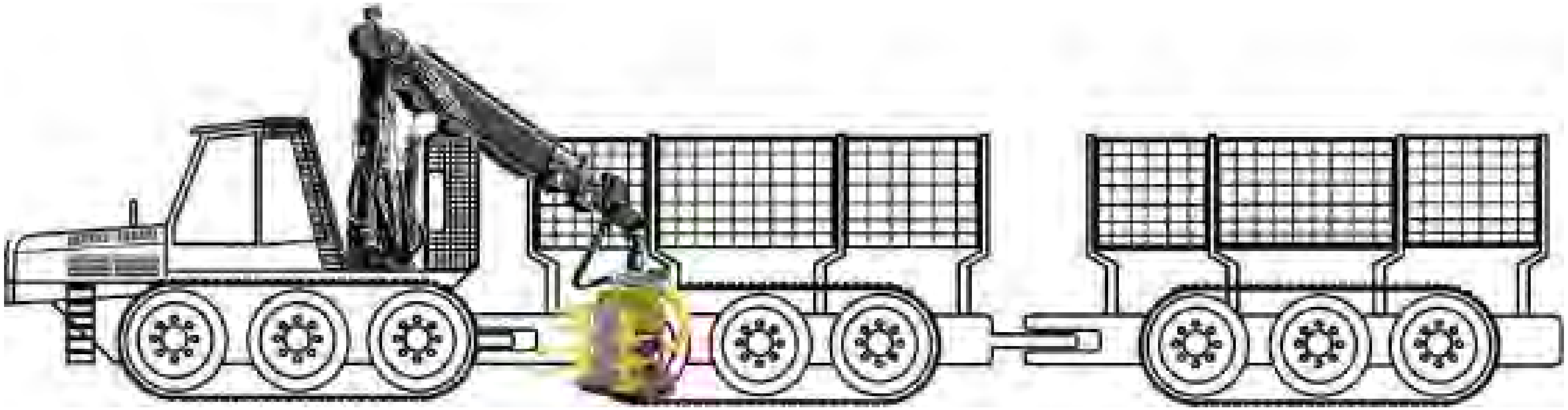
APPENDICES

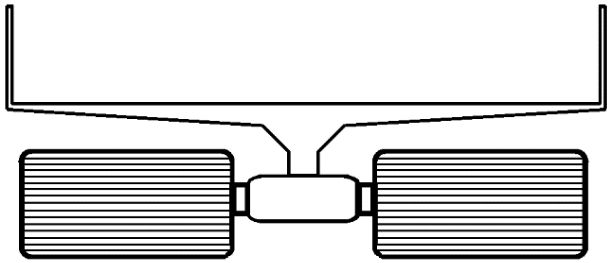
A. Existing Commercial/Semi-Commercial Harvesting System Excavator and Tree Shear/Cutting Head, Whole Tree Forwarder






B. Mostex Single Pass Solution for Sub-Optimal /Semi-Commercial Crops





C. Mostex Reactor Photos

Filling Reactor

Raw Material (R)
Steam Exploded (L)

The Reactor System

D. Image of [redacted] Reactor

[redacted]

MOSTEX

E. Analysis of Different Feedstocks

Analysis	Method	Unit	Drax	Bagasse
Ash content at 550 ºC	SS-EN 14775	% of dry matter	2.00	0.40
Net Calorific Value	SS-EN 14919	MJ/Kg dry matter	16.50	19.40
Sulphur at 1050 ºC	EN ISO 16994	% of dry matter	0.08	0.01
Nitrogen at 1050 ºC	EN ISO 16948	% of dry matter	0.30	0.06
Chlorine	SS 187154	% of dry matter	0.03	0.01
Initial Deformation Temp	SIS-CEN/TS 15370	ºC	1150	1500

Analysis	Method	Unit	Drax	Arundo Donax
Ash content at 550 ºC	SS-EN 14775	% of dry matter	2.00	0.60
Net Calorific Value	SS-EN 14919	MJ/Kg dry matter	16.50	17.84
Sulphur at 1050 ºC	EN ISO 16994	% of dry matter	0.08	0.01
Nitrogen at 1050 ºC	EN ISO 16948	% of dry matter	0.30	0.08
Chlorine	SS 187154	% of dry matter	0.03	0.01
Initial Deformation Temp	SIS-CEN/TS 15370	ºC	1150	1550

F. End Users Scotland

Supplier	No. Of Approvals
AMP Biomass Fuel Ltd	95
Verdo Renewables Ltd	17
LC Energy Ltd	14
PBE Fuels Ltd	10
Verdenergy (Yorkshire) Limited	10
Mole Valley Farmers Ltd	6
Pellet Co Limited	6
Y Pellets	5
Caledonian Pellets	4
Midland Bio Energy Ltd	4
Afterwood Ltd	4
Banwy Fuels Ltd	3
Brough Construction Ltd	3
James D Bilsland Ltd	3
Pearsons of Duns Ltd	3
R A Owen and Sons	3
White Horse Energy	3
The Good Fuel Company Ltd	2
Surefire fuels ltd	2
Pressuretech Transport Services Ltd t/a BDS Fuels	2
Wynnstay (Agricultural Supplies) ltd	1
Cows & Co Energy	1
Tincknell Country Store	1
J T Atkinson & Sons ltd	1
Logs Direct Ltd	1
MIG 100 LIMITED	1
Ness Engineering Ltd	1
Pelletsfirst	1
B D Supplies Limited	1
Billington Bioenergy Ltd	1
Blue Fuchsia Ltd	1
Border Biofuels Ltd	1
Hayes Fuels	1
Norton Bio Fuels Ltd	1
Nottinghamshire Eco Fuels Limited	1
Q-Solve	1
SDL Biomass Ltd t/a SDL Solutions	1

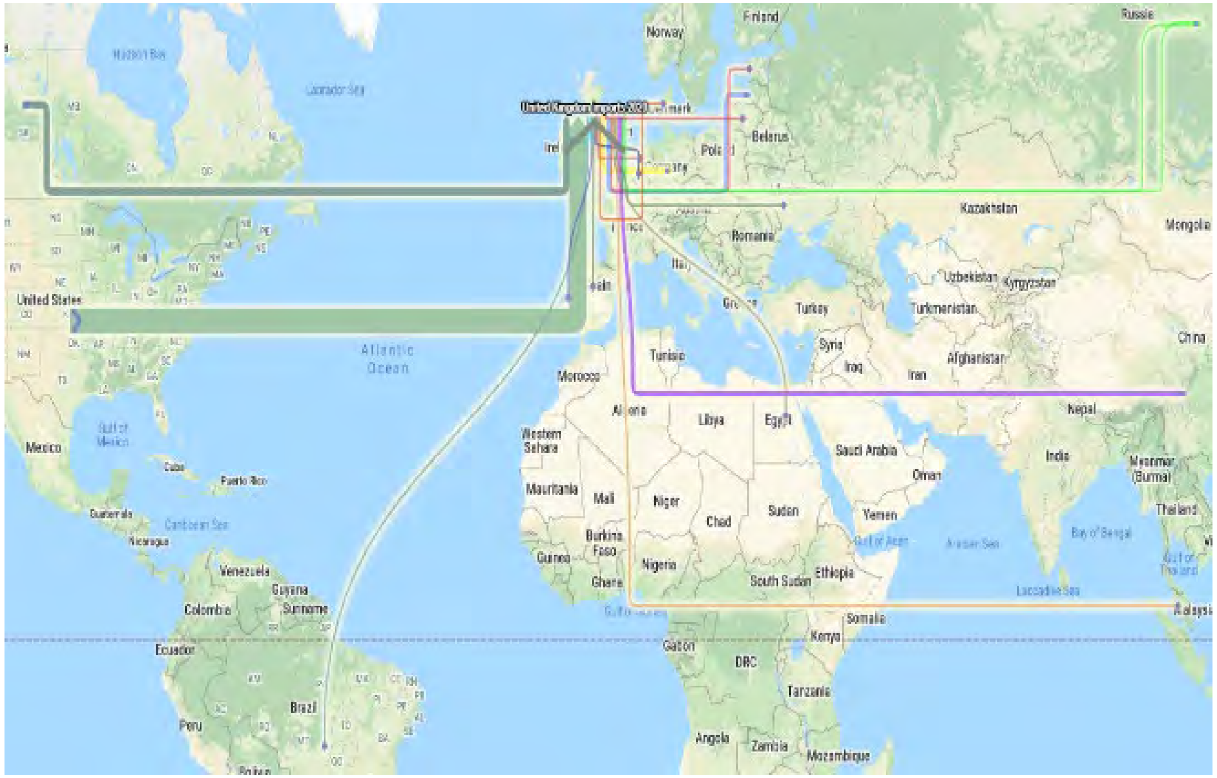
Manufacture & Retail	No. Of Approvals
Balcas Timber Ltd	78
Land Energy Girvan	2
Puffin Pellets	2
Blazers Fuels Ltd	3
High Park Industries Limited	2

Import/Wholesale	No. Of Approvals
PelTrade Ltd	52
CM Biomass Partners	25
Pure Biofuel / Simply Wood Pellets	6
Pellet 4Energia SIA	2
LesResurs	1
Palser Bioenergia e Paletes Lda	1

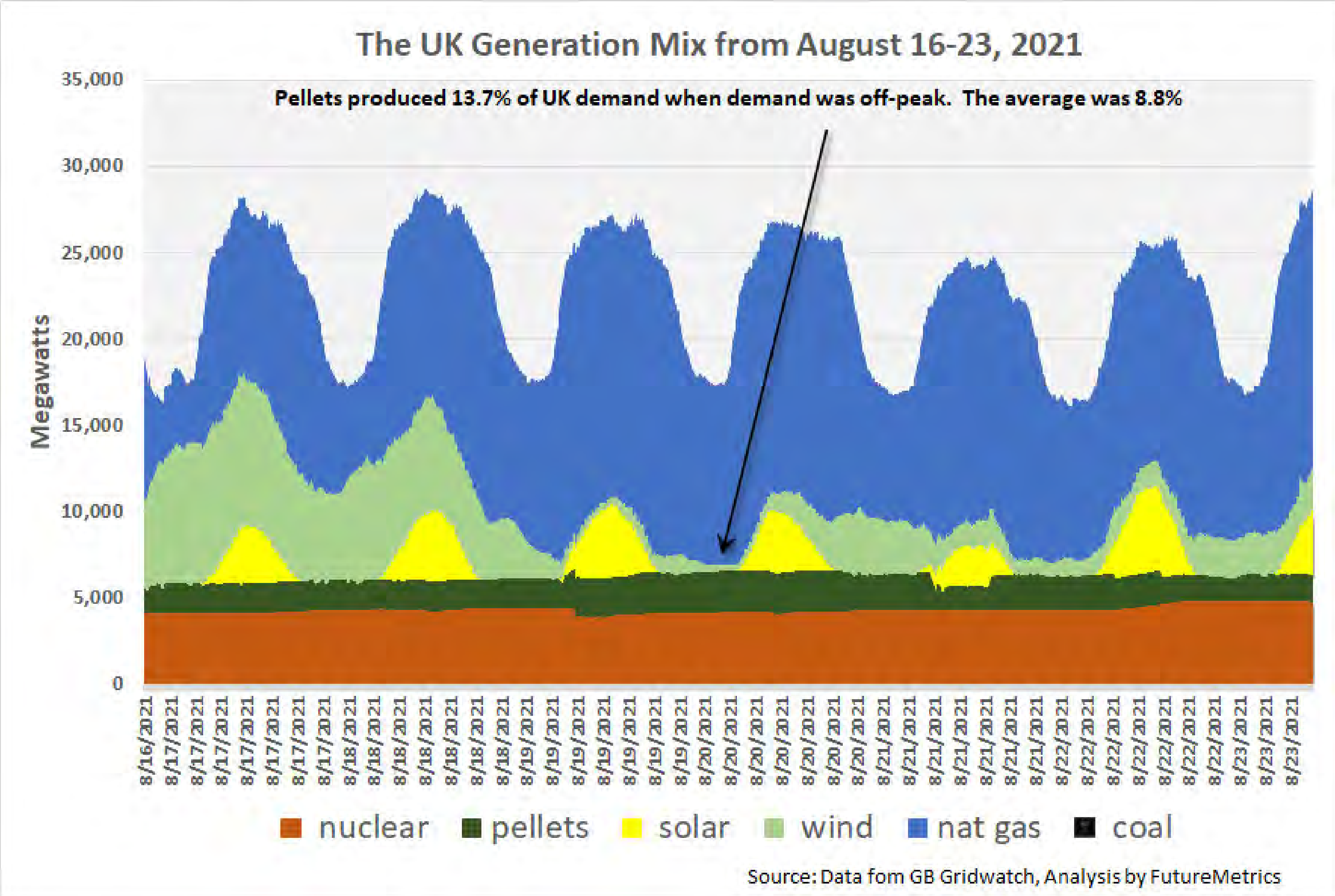
MOSTEX

G. UK Pellet Imports

United Kingdom imports 2020		
United States to United Kingdom	5,766,280	Metric Tonnes
Canada to United Kingdom	1,566,553	Metric Tonnes
Latvia to United Kingdom	851,489	Metric Tonnes
Russia to United Kingdom	258,446	Metric Tonnes
Estonia to United Kingdom	254,640	Metric Tonnes
Brazil to United Kingdom	186,777	Metric Tonnes
Portugal to United Kingdom	138,474	Metric Tonnes
Malaysia to United Kingdom	7,673	Metric Tonnes
Germany to United Kingdom	6,846	Metric Tonnes
Ireland to United Kingdom	4,883	Metric Tonnes
Lithuania to United Kingdom	4,166	Metric Tonnes
Netherlands to United Kingdom	4,029	Metric Tonnes
Spain to United Kingdom	2,270	Metric Tonnes
Ukraine to United Kingdom	1,174	Metric Tonnes
Belgium to United Kingdom	486	Metric Tonnes
Egypt to United Kingdom	379	Metric Tonnes
Germany to United Kingdom	136	Metric Tonnes
Russia to United Kingdom	67	Metric Tonnes
China to United Kingdom	62	Metric Tonnes
China to United Kingdom	60	Metric Tonnes
Denmark to United Kingdom	58	Metric Tonnes
Total	9,054,948	Metric Tonnes



H. Renewable Supply



I. Gantt Chart

[redacted]

J. Letter of Support from SSE

[redacted]

[redacted]

MOSTEX

K. Risk Register

Risk No.	WP	Time	Risk	Probability	Severity	Risk Score	Mitigation
Project Management Related Risks							
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted] backups
Technical Risks							
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

MOSTEX

[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Deployment & Testing Risks							
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Commercial Related Risks							
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

L. GHG Model

Carbon Footprint for Strathy Plant

CO_2 Data		
[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]

Fuel Production and Delivery	gCO_2/dry tonne	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	

Operating Assumptions	
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]

Power Station Conversion to Electricity	
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]

M. Financial Models and Assumptions

[redacted]

i) Sales

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

ii) Raw Material

[redacted]

[redacted]

[redacted]

iii) Production

[redacted]

MOSTEX

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

iv) Reactor

[redacted]

[redacted]

[redacted]

[redacted]

v) Capex

[redacted]

[redacted]

vi) Local Site Costs

[redacted]ce.

vii) Group Management

[redacted]

viii) Taxation and Interest

[redacted]

Financial Model		
[redacted]	[redacted]	
Revenue	£	
[redacted]	[redacted]	
Costs		
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
Total Costs	[redacted]	[redacted]
EBITDA	[redacted]	[redacted]
Depreciation	[redacted]	
EBIT	[redacted]	

MOSTEX

Timber Supply: Total Site 1100HA									
Forest Split	**%**	**Ha**							
[redacted]	[redacted]	[redacted]							
[redacted]	[redacted]	[redacted]							
[redacted]	[redacted]	[redacted]							
[redacted]	[redacted]	[redacted]							
Conventional Scenario	**Ha**	**t/Ha**	**Total t**	**Harvesting £/t**	**Chipping £/t**	**Haul to Plant £/t**	**Loading/ Handling**	**Total £/t**	**Total £**
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total	[redacted]		[redacted]					[redacted]	
[redacted]	[redacted]		[redacted]						
[redacted]	[redacted]		[redacted]						
Annual Cost			[redacted]						
Mostex Scenario									
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]		[redacted]					[redacted]	
[redacted]	[redacted]		[redacted]						
[redacted]	[redacted]		[redacted]						
Annual Cost			[redacted]						

Product Markets						
Product Markets & Sales	**% Split**	**Dry Tonnes**	**Product Moisture %**	**Tonnes**	**£/t ex-works**	**Total £**
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total	[redacted]	[redacted]		[redacted]	[redacted]	[redacted]

Argus December 2021	$/t	£/$	£/t			
[redacted]	[redacted]	[redacted]	[redacted]			

	$/MWh	£/$	£/MWh	NCV	£/t	
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	
[redacted]						
	Euro/t	**£/Euro**	**£/t**			
[redacted]	[redacted]	[redacted]	[redacted]			
[redacted]						
[redacted]	[redacted]					
[redacted]	[redacted]					

Plant Assumptions	
Raw Material	
[redacted]	[redacted]
Production Dry Tonnes	[redacted]
Moisture Content	
[redacted]	[redacted]
Labour (£)	
[redacted]	[redacted]
Labour total	[redacted]
Other Direct O&M Costs (£)	
[redacted]	[redacted]
Total	[redacted]

Utilities		
[redacted]	[redacted]	
Total Power	[redacted]	kW
Cost of Electricity	[redacted]	£/kWh
Steam Requirement		
[redacted]	[redacted]	kWh/dry tonne
[redacted]		
[redacted]	[redacted]	kg
[redacted]	[redacted]	kWh
Total Steam Requirement	[redacted]	kWh/dry tonne
[redacted]	[redacted]	
Total Cost of Steam	[redacted]	£/kWh

Steam Calculations		
[redacted]		
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
Feedstock		
[redacted]	[redacted] %	
[redacted]	[redacted]	kg/m^3
[redacted]	[redacted]	m^3
[redacted]	[redacted]	Tonnes
[redacted]	[redacted]	Dry Tonnes
[redacted]	[redacted]	Dry Tonnes

[redacted]		
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	
[redacted]	[redacted]	m^3
[redacted]	[redacted]	m^3
[redacted]	[redacted]	
[redacted]	[redacted]	m^3
[redacted]	[redacted]	kg/m^3
[redacted]	[redacted]	kg
[redacted]	[redacted]	
[redacted]	[redacted]	kg
Total Steam Required/Dry Tonne	[redacted]	**kWh**

Capital Expenditure Requirements				
[redacted]	[redacted]	[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]		
[redacted]		[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]	[redacted]	
[redacted]		[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]	[redacted]	
[redacted]		[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]	[redacted]	
[redacted]		[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]	[redacted]	
[redacted]		[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	
[redacted]		[redacted]	[redacted]	
[redacted]	[redacted]	[redacted]	[redacted]	
Total Containers	[redacted]			

N. Phase 2 Initial Budget: January 2022

Phase 2 Initial Budget: January 2022											
WP No.	WP Title	WP Lead	WP Start	WP End	Labour £	Materials £	Sub-Contract £	T&S £	O/H @ 20% £	Total £	% of Budget
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]			[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]			[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]			[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]			[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]			[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]