Green Distilleries Application Form

Proposal Summary

1. Name of Bidder (This should be the lead organisation/co-ordinator for the proposed project)

Colorado Construction & Engineering Ltd

2. Project Name

BatGasDW: Batch Gasification of Distillery Waste Biomass for renewable distillery fuel

3. Project Lot Number?

2

4. Technology Type/Category

fuel switching enabling technology

5. Estimated Start Date

* 14/06/2021

6. Project Duration (months)

1 21

7. Estimated End Date

* 15/03/2023

8. Total Project Cost (£)

3056117

9. Total BEIS Funding applied for (£)

2936617

10. Project Summary (please provide one or two sentences)

Design, demonstration and rollout of a batch-gasification proposal, using a biofuel gasifier and associated reactive fuel burner.

11. Public Description of the Project - The public description of the project should be a brief non-confidential description of the project that BEIS may use in online or printed publications. Please describe the project objectives and key deliverables and the expected project benefits. Maximum 300 words

PROJECT OBJECTIVES
The objective of Phase 1 was to design a batch-gasification proposal, using a biofuel gasifier and associated reactive fuel burner. Biofuels can be understood as a nomenclature that constitutes a range of biooils and biomass(es) which can be gasified in this solution to generate steam heat energy for the distillery sector.
The first objective in Phase 2 is to demonstrate that the gasification proposal is a practical solution for both directly fired and steam heated distillation. This will be done at our proposed Livingston Centre for Industrial Decarbonisation (LCID).
The second objective in Phase 2 will be to roll out the technology as a viable solution to individual distilleries.

KEY DELIVERABLES
Phase 2 will deliver the manufactured gasifier so as to demonstrate their combustion performance at distillery conditions via the batch-gasification test rig at the LCID.
We have designed and tested a 350kW gasifier as well as the associated reactive fuel burner, both of which operate with low NOx.
We have developed the gasifier to incorporate a range of biofuels – both liquid and solid – whilst making use of distillery by-products such as waste draff. The gasifier can also incorporate agricultural materials, e.g. barley straw, so as to facilitate circular economies.
The primary lean reactive fuel burner will be tested using NG and ethanol as the fuel but will also be made to be hydrogen ready.

PROJECT BENEFITS
• The benefit of our solution is massive decarbonisation of distillery power production using biofuels (and hydrogen as the reactive fuel).
• Facilitates the use of distillery by-products, e.g. waste draff, as well the use of sustainable and low-cost biomass fuel sources.
This versatile gasification solution can be adapted to any steam boiler application.

Eligibility Criteria

12. Eligibility Criteria

	Yes	No
1. Project Led - ***Projects must be led by a UK based company the same company that led Phase 1. The demonstration study must also take place in the UK.*** **Is the project being led by the same company that led Phase 1, and that the demonstration study will take place in the UK?**	X	
2. Technology and Transferability - ***The technology must be directly transferable to the distillation sector, including from maltings through to maturation.*** **Is the technology transferable to the distillation sector (from malting to maturation)?**	X	
3. Innovation and technology readiness - ***This Competition is to support the development of innovative fuel switching or fuel-switch enabling technologies that are directly transferable to the distilleries sector (from malting to maturation). It is to support the development of technologies that are not yet commercial from Technology Readiness Levels (TRLs) 4 to 7 at the start of the projects.*** **Will your technology/ system be at TRL 4 – 7 at the start of the project?**	X	
4. Innovation and technology readiness - ***The focus of the Competition is to support the development of innovative fuel switching or fuel switch enabling technologies that are directly transferable to the distilleries sector (from malting to maturation).***		

Exclusions: Funding will not be provided for projects where the technology development focuses on: ***- CCUS (Carbon Capture Utilisation and Storage)*** ***- Energy efficiency (apart from heat pumps which is in scope)*** ***- Switching of feedstocks, (except where feedstock provides chemical energy to drive the process)*** **Does your project exclude the technologies listed above?**	X	
5. Project status ***- BEIS is unable to fund retrospective work on projects.*** **Can you confirm that your application does not seek funding for retrospective work on this project?**	X	
6. Additionality ***- Projects can only be funded where evidence can be provided that innovation would not be taken forwards (or would be taken forwards at a much slower rate) without public sector funding.*** **Can you confirm the funding requested from BEIS for your project cost for Phase 2 will be equal to or below £3m?**	X	
7. Contract size ***- Phase 2 – Demonstration phase (SBRI): Split into Lot 1 (up to £5.99m) and lot 2 (up to £3m) with a total of £8.99m. The maximum funding available per project is £3m. If we don't receive sufficient bids (in number or in quality) to use the funding from one Lot we will reallocate funding to the other Lot if the bids in that Lot score the 60% pass mark All projects will be ranked against the assessment process and criteria (section 7). Demonstration studies must be complete by 12pm (noon) BST 15th March 2023.*** **Can you confirm the funding requested from BEIS for your project cost for Phase 2 will be equal to or below £3m?**	X	
8. Eligible project costs ***- SBRI is aimed at organisations working on research and development (R&D) of an innovative process, material, device, product, or service prior to commercialisation. Funding is available for R&D activities only, including related dissemination activity. Projects requesting funding for commercialisation activities are not eligible.*** ***The full list of eligible project costs is set out in Appendix 2 and outlined in Section 5 of the Green Distilleries Phase 2 Application Notes.*** **Can you confirm that requested funding is for eligible costs only?**	X	
9. Project end date ***- Phase 2 Demonstration Studies must be completed and approved by BEIS (projects need to allow for time for the BEIS monitoring officer to review the demonstration study final report and amend accordingly) by 12pm noon GMT 15th March 2023.*** **Can you confirm that the project will meet the specified project end dates?**	X	
10. Risk-Benefit sharing ***- The sharing of risks and benefits is an important aspect to the SBRI approach. Projects receive financial support and retain any intellectual property generated, with certain rights of use retained by BEIS. Project outputs are also expected to be shared widely and publicly and project teams are not permitted to include profit in the eligible project costs.*** **Do you agree to this approach?**	X	
11. Applicants and Project Team Make-up ***- The Phase 2 Demonstration project is expected to be delivered by a project team or consortium. A single project application must be submitted by the lead project member (the project co-ordinator).*** ***Members of the project team can be:*** ***• Private sector companies: both SMEs and large enterprises can apply as sole applicants or as part of a consortium with other private sector companies, or in a consortium with academic, research or public sector organisations.*** ***• Academic, research, public, third sector or community organisations must work as part of a project consortium with private sector organisations – they cannot be sole applicants to this competition.***	X	

The project team co-ordinator can be a private sector company, academic, research, public, third sector or community organisation as long as they have the necessary skills and capacity to effectively lead the proposed demonstration project and have a route to market. **Can you confirm that your project team meets eligible organisation requirements?**		
12. Planning, Regulatory and Environmental Permissions - ***Where planning, regulatory and environmental permits are required, the applicants must ensure that these permits will be in place to successfully complete the demonstration before the end of the Phase 2 Demonstration Study (12pm noon GMT 15th March 2023).*** **Can you confirm that the necessary permits required to successfully deliver the Green Distilleries Phase 2 project will be in place to successfully complete the demonstration before the end of the Phase 2 Demonstration Study (12pm noon GMT 15th March 2023)?**	X	

13. Delivering multiple projects - If project consortium member(s) are part of multiple successful bids they must be able to deliver on them and they must not have applied for funding for the same piece of work more than once.

	Yes	No
13 (a) Eligibility question: If you or your consortium are part of multiple successful bids would you be able to successfully deliver all projects if necessary?	X	
13 (b) Eligibility question: If you or your consortium are part of multiple successful bids could you please confirm that you have not applied for funding for the same piece of work more than once?	X	

Contact and Organisation Details

1. Colorado Construction & Engineering Ltd Contact Details

Title	[redacted]
Name	[This has been redacted]
Position	[This has been redacted]
Email	[This has been redacted]
Mobile Number	[This has been redacted]
Organisation Website	https://colorado-group.com/

2. Organisation Name

Colorado Construction & Engineering Ltd

3. The registered address of the Lead Organisation

Address Line 1 11 Caputhall Road, Deans Industrial Estate

Address Line 2 -

Address Line 3 -

Town/City Livingston

Postcode EH54 8AS

4. County

West Lothian

5. UK Region

Scotland

6. Country

United Kingdom

7. Project Location: Is this registered address the location where the main activity of the proposed project will be carried out? If the answer is No you will be asked to provide location details in the separate Project Cost Breakdown Form.

Yes

8. Organisation Type

Private Company

9. Organisation Size

Small Enterprise <50 employees

10. Number of employees (including directors)

[redacted]

[redacted]

13. Turnover Date (in most recent annual accounts)

* 30/11/2019

14. Balance Sheet Total (total assets net of depreciation)

[This has been redacted]

[This has been redacted]

19. Organisation Status: a brief introductory description of the company to set the scene for the assessors Maximum 250 words

UNIVERSITY OF LEEDS (UOL)

UoL is one of the UK's largest Universities with a turnover of £674M and a research income of £131M, including £19.25M of UK Government contracts which it is used to managing. The University has one of the UK's largest Engineering Faculties with a 112-year history in energy research, most of it housed within the School of Chemical and Process Engineering.

Summary of role (SOR): UoL have invented the gasifier furnace and the associated reactive fuel burner that will be used in our proof of concept.

COLORADO CONSTRUCTION & ENGINEERING LTD

CCEL is a renowned Scottish engineering and construction contractor, with a specialisation in the design and build of distilleries and visitor centres.

The company has constructed or expanded ten distilleries, and has undertaken construction/M&E works for an additional 30 distilleries. The business works for distilleries throughout Scotland and the islands and has extensive experience and relationships in the sector.

SOR: CCEL will provide the Centre of Industrial Decarbonisation in Livingston and will be the lead organisation/co-ordinator for the project.

CLEAN BURNER SYSTEMS

CBS is a leading manufacturer of gas burners and components for commercial and industrial operations. CBS's range of burners are completely designed, built and tested at facilities in Rugby, England. This ensures customers (which include major appliance manufacturers) benefit from rapid response times, smaller lead times, and a reduced carbon footprint.

SOR: CBS will manufacture the gasifier and the associated reactive fuel burner and be the primary route to market in the dissemination phase.

20. Does the organisation have a parent company? (If yes you will be asked to provide details)

Yes

Parent Company Details

21. Parent Company Details

Organisation Name	Colorado Group Ltd
Address Line 1	11 Caputhall Road
Address Line 2	Deans Industrial Estate
Address Line 3	-
Town/City	Livingston
Postcode	EH54 8AS

22. Country

United Kingdom

23. Number of employees (including directors)
[redacted]
[redacted]
[redacted]

28. Balance Sheet Date (total assets net of depreciation)
* 30/11/2019

29. Organisation Maturity
1-5 years

1. Description of novel technology, technical feasibility, replicability and performance of Green Distilleries solution

1a. Please give a high level description of the proposed Green Distilleries solution, including a description of the novel technology, its technical feasibility and its replicability. (5%) (applicants can use the upload link to provide supporting evidence and illustrations, any further text beyond the word limit will not be assessed) With reference to the Phase 1 Feasibility study, applicants are expected to: Describe the technology readiness level (TRL) at the start of the project, and at the end of the Phase 2 Project. Describe why the Green Distilleries solution is novel and how it will support the decarbonisation of the distilleries sector. Describe how the proposed Green Distilleries Solution can be replicated across the distilleries sector and the advantages of this solution over other state of the art technologies. Describe how the solution(s) work, including a description of your engineering design for the demonstration, and how it fits into distillery processes to enable decarbonisation of the sector. Provide evidence to demonstrate that the proposed approach is technically feasible, providing justifications for all technical data provided. This should reference earlier feasibility work, including engineering designs, engineering calculations and the outputs of other feasibility research Explain how the outputs of the feasibility work you have carried out to date have informed your engineering design. Explain how your demonstration project will accelerate the development of fuel switching/fuel switch enabling technologies Describe the potential challenges and barriers of the proposed solution and how they will be overcome/mitigated. (Maximum 2000 words)

INTRODUCTION
To support the Government with its ambitious plans of the Ten Point Plan for a Green Industrial Revolution, Colorado Construction and Engineering Ltd (CCEL) plan to develop a novel biofuel gasification system. This can help transition all direct fired and steam heated distillery operations towards total carbon neutrality. Biofuel(s) can be understood as a nomenclature that constitutes a range of biooils and biomass(es) which can be gasified in this solution to generate steam heat energy for the distillery sector.

The CCEL solution will enable Distilleries to retrofit current boilers with the means to gasify low-cost biofuels to replace their current legacy fuels. This will involve an easily manufactured and retrofitted gasification burner and furnace system that is capable of gasifying biofuels downstream of a more reactive fuel such as natural gas (NG), ethanol, and/or hydrogen.
The solution has five principal components:
1) A lean burning grid cone reactive fuel burner will be used to flame heat the gasifier to 800-900K. This will operate at Ø of 0.2 using a reactive fuel (NG, green hydrogen or ethanol) to deliver the hot gas with 16% oxygen to produce rich flames in the gasifier at about 2Ø.
2) The gasifier furnace (2mL, 1mW, 1.5mH) in which the gasification will take place. Rich burning gasification occurs at the surface, heating the biofuel below and releasing volatiles that pass upward. Damp biomass (such as draff) is dried by the furnace heat below the reaction surface. The furnace will be fed via a removable end wall and a bio-oil inlet pipe.
3) Additional bio-oil can be added at this point to improve gasification.
4) The resultant BGG (LCV Bio-gasification gas) will be burnt in an LCV Jet Mix burner developed by University of Leeds, for heating steam boilers. This will produce 280 kW of the overall 350kW needed for direct firing or the distillery boiler.
5) A feed to the distillery feedwater in the hotwell tank will be heated using surplus BGG gas during periods when the distillery is between batches and if the gasifier is still producing BGG.
Our BEIS Phase 1 trials have demonstrated that draff, crude glycerol and VOs can be gasified. The Phase 1 GCV measurements show that 23% of the energy in the biomass could come from distillery waste draff. Notably, this is an essentially free energy source. Thus, not only could decarbonisation be achieved, but it can be used to minimise operating costs.

A) TRL
In January 2021, the University of Leeds (UoL) – working as part of the BEIS Glass Futures fuel switching programme – successfully demonstrated a 100% biofuel firing of the Encirc container glass plant in Derrylin in N. Ireland. Subsequently, the present proposals to decarbonise the distillery industry on biofuels, or hydrogen/biofuels staged combustion, are practical and offer a solution to early decarbonisation. Learning the lessons from that trial and other associated world leading Green-tech research at UoL, we have made exceptional progress towards our Phase 1 goals. We are pleased to report that the project started at TRL4 and will be TRL8 by the end of Phase 2. This is an improvement from TRL6/7 in our original Phase 1 application.

B) NOVELTY
The gasification of biofuel in steam boilers in distilleries is novel. Our proposed solution is based on switching from NG to biofuels. This will involve a gasification burner and furnace design that is capable of gasifying biofuels downstream of a more reactive fuel such as natural gas (NG), ethanol, and/or hydrogen. These gasifiers will be connected to the existing steam boilers to have a >60% thermal efficiency.

This versatile multi-biomass gasifier can be adapted to any steam boiler application as well as any biomass source depending on local availability. The versatility of this approach is not limited to the immediate availability of hydrogen but allows for a multi-biomass solution that can begin decarbonisation efforts from 2023 whilst burning hydrogen fuel to replace the NG when it becomes more widely available.

All distilleries:
• The gasifier and the associated reactive fuel burner is a practical solution for directly fired and steam heated distillation.
Whisky distilleries:
• The process will consume by-products such as draff and PAS alongside additional biofuel materials, saving the offsite disposal costs and the transport emissions associated with offsite disposal.
• It is a highly visible ecological solution that can be presented to Distillery visitors as part of their Distillery experience. If it meets with your approval, each furnace will feature a ‘developed with BEIS Green Energy funding’ logo/faceplate.

Commercial features:
• Where possible, it will consume locally produced agricultural or other bio by-products (eg Straw & Miscanthus), facilitating closed-loop solutions (AppendixM&N).

C) REPLICATION
Our gasifiers will be easy to run in parallel, presenting a modular solution that can be scaled up to any size by using multiple gasifiers in a single distillery. The simple modular design also makes the solution highly replicable.

The design principles of the gasifier enable any burner thermal output to be developed as the gasifier heater burner and BGG burner total heat release rate is controlled by the air flow. For direct fired distillery applications, the same BGG burners will be used but sized to locate heat in the same way as on the current direct fired distilleries. The biggest cost in scaling up to this solution will be the installation multiple gasifiers. This will be the main associated cost increase.

- Advantages over other technologies
No other solution offers decarbonisation with reduced operational costs, apart from the axial stage burner proposal (lot 1) also offered by CCEL. Advantages include the following:
• Ready to go – Based on the progress of our Phase 1 trial, we are confident that the solution can be deployed in early 2023.
• Fuel agnostic – Distilleries are located in a wide variety of places with a high degree of difference in terms of their needs and access to fuel sources.
• Minimise grid loss – Due to grid-loss, electricity from biofuels only delivers approx. 30% thermal efficiency at the distillery gate. Gasification of biofuels at the distillery achieves 60%+ thermal efficiency.

Burning the biofuel raw in a conventional burner would produce hydrocarbon, CO and soot emission problems. However, burning low CV gases (our solution) produces low NOx due to their lower peak temperatures. Gasification produces a clean gas that burns with secondary air under lean conditions and thus hydrocarbons and CO are oxidised.

AD is a viable route to the use of waste biofuels in distilleries. However, small scale distillation site scale AD plant are expensive and typical efficiencies vary from 6%-30% depending on the size of the plant (AppendixH). In comparison, our proposed optimised gasification route offers gas production efficiencies of greater than 70% and combustion efficiencies close to 100%.

D) HOW THE SOLUTION(S) WORK
The solution works by using a reactive fuel (hydrogen/ethanol/NG) to burn very lean in a novel reactive burner that heats a biofuel gasifier to about 800-900K and creates a rich equivalence ratio (Ø) of about 2 in the furnace. TGA analysis of the draff waste, other agricultural biomass and crude glycerol has shown that 90% of the volatile weight loss occurs below 850K and the volatiles released are typically 73% of the initial mass with 20% char and 7% water (Draff composition). Essentially, the volatiles burn rich and yield CO and hydrogen and hydrocarbons in the bio-gasification gas (BGG), which then passes hot from the gasifier to the novel BGG burner which, in turn, fires the existing steam boiler for indirect heating of the distillation process OR directly fires the distillation process using an array of new BGG burners. See AppendixL for further details.

E) EVIDENCE OF TECHNOLOGICAL FEASIBILITY
The proposal is centred on an evidence and fact led methodology that seeks to achieve the most innovative, deliverable and cost-effective solution available. The proposal is based on extensive research at UoL on compartment gasification in furnaces similar to that proposed for the 350-kW demonstration. Moreover, the principles in this proposal are used in current log or gasification boilers (AppendixB) where biofuel energy is converted into heat with 90%+ thermal efficiency. This is much higher than conventional steam injected gasifiers achieve.

F) ENGINEERING DESIGN
Using samples supplied by Inchdairnie distillery, the feasibility work to date has shown that draff and crude glycerol can be gasified. Their composition has also been determined (AppendixC). We have also secured supplies of crude glycerol and crude ethanol that are local to LCID as well as close to a range of distilleries.

- Enabling decarbonisation

Draff has a CV of about 11 MJ/kg and so this is an energy of 2.09 MJ/litre of whisky. Notably, 23% of the energy in the biofuel could come from distillery waste draff. This is an essentially free energy source. Even if NG is used for the reactive burner, there will still be a substantial decarbonisation as 79% of the steam boiler energy will come from this draff and any additional biofuel.

The present flame heated gasifier approach gives a viable transition to decarbonisation, using renewable biofuels that can start in 2023. It can later use hydrogen as the reactive fuel (rather than NG) to heat the gasifier.

The gasification of biofuel enables a much wider range of low-cost biofuels and distillery waste to be

used and this fuel-cost reduction means that decarbonisation will be achieved with reduced costs. A biofuel to steam energy conversion thermal efficiency of >60% is possible using the proposed gasification technology, which is at least twice the overall thermal efficiency of AD bio-gas supply with an offsite AD plant.

G) ACCELERATION OF THE DEVELOPMENT OF FUEL SWITCHING/FUEL SWITCH ENABLING TECHNOLOGIES
We know from discussions that CCEL has held with its customers across the industry that most distilleries are keen to achieve decarbonisation if they can do so without increasing cost, without interrupting production and with no impact to the quality of the whisky produced.

The demonstration project will show that the use of a reactive primary fuel (NG/ethanol/hydrogen) in the lean burner, coupled with biofuels in the heated gasifier, can produce a BGG that can be burnt in the steam boiler for heating distilleries. Fuel switching from NG to mixtures of hydrogen, ethanol, draff, biodiesel, RVO and farm waste such as barley straw will be demonstrated.

The range of available biofuels will enable the lowest cost fuels to be used, and as most of these fuels are a lower cost than NG – apart from hydrogen and ethanol – an overall reduction in operating costs will be achieved. As the reactive burner that heats the gasifier will operate very lean (at ~Ø=0.2), the proportion of more expensive green reactive fuels (ethanol/hydrogen) will be lower than in a dual fuel burner and, in turn, the operating costs will be lower.

H) POTENTIAL CHALLENGES AND MITIGATIONS
There is a problem with the water content of biofuels. However, our goal is that steam produced from rapid flame heated water will combine with C and CO to yield additional hydrogen. In conventional gasifiers, steam is injected to increase hydrogen yield and if this can be achieved in this flame heated batch biomass gasifier then that would improve the thermal efficiency. The hydrogen yield will be determined in the development of the full-scale gasifier.

The challenge in this burner design is the acceptance of the unconventional batch biofuel gasifier, with flame heating from the reactive burner, whilst not using the energy of the biofuel to heat the furnace.

Although the Jet Mix burner for the BGG gas combustion in the steam boiler has not been demonstrated in the feasibility work, its operation in the offset jet mode (AppendixB) should result in stable flames. This is because combustion will be at high a gas temperature but ambient air temperature.

The offset jet configuration will give an array of local rich/lean combustion which is good for flame stability. If this burner does not operate satisfactorily, a radial air flow burner with central BGG injection will be used. This is a more complex burner design than for the Jet Mix in terms of the air supply, but it offers good flame stability.

To provide supporting evidence and illustrations upload your file/s here. Please do not upload any further text in order to go beyond the word limit, it will not be assessed. Max upload size per file - 10MB Max number of files - 5

- File: CCEL - Lot 2 BatGasDW - Appendix B - Solution schematic.pptx - Download
- File: CCEL - Lot 2 BatGasDW - Appendix C - University of Leeds publications.docx - Download
- File: CCEL - Lot 2 BatGasDW - Appendix H Efficiency of AD.docx - Download
- File: CCEL - Lot 2 BatGasDW - Appendix J - Composition of different biofuels.docx - Download
- File: CCEL - Lot 2 BatGasDW - Appendix L - Gasifier Design.pdf - Download

1b. Please give a high-level description of the performance of the Green Distilleries solution. (15%) (applicants can use the upload link to provide supporting evidence and illustrations, any further text beyond the word limit will not be assessed) With reference to the Phase 1 Feasibility study, applicants are expected to: Identify and compare the performance of their solution with other state of the art technologies Describe the technical and commercial advantages of your solution over other state of the art technologies Describe the scalability of the solution and applicability/replicability across different distillery sites (is the technology transferable to other industrial sectors?) Describe costs of the solution, providing a detailed analysis on the lifetime costs of your solution costs (including CAPEX and OPEX) comparing these costs to other state of the art technologies. Describe how the solution will impact product quality, costs and output.

Identify any uncertainties associated with these cost estimates and how the design and execution of your demonstration study will address these uncertainties Explain the impact the solution would have on a site in terms of health & safety, air quality, fuel delivery logistics and production disruption and how the applicant will ensure the necessary risk assessments and training will be carried out. (provide a qualitative and quantitative comparisons to these impacts relative to the current state of the art technologies) Explain where planning permission/environmental permits are required, the applicant must justify and provide reasoning as to how these permits will be in place to successfully complete the demonstration before the end of the Phase 2 Demonstration Study (12pm noon GMT 15th March 2023) (Maximum 2000 words)

INTRODUCTION
This proposal will enable an evolution from the current method of burning fossil fuels in traditional boilers to a low carbon solution using a variety of biofuels. Biofuels can be understood as a nomenclature that constitutes a range of biooils and biomass(es) which can be gasified to generate steam heat energy for the distillery sector (AppendixJ).

Whisky production results in substantial bio by-products. Zero Waste Scotland calculates that the industry produces 500,000 tonnes of draff a year. This by-product currently has secondary low value commercial markets, but these may be transient. Notably, the batch gasification proposal will use the draff distillery waste to provide 23% of the distillery's energy needs.

This proposal offers the potential for an immediate start to the decarbonisation of Whisky distilleries, by fuel switching to gasified biofuels. We can achieve this by retrofitting current boilers with the means to gasify low-cost biofuel alongside their current legacy fuels. Furthermore, the solution is future proof since the legacy fuel can, at a later date, be upgraded to hydrogen with no impact on the overall solution.

The present flame heated biomass gasifier approach, proven in our Phase 1 feasibility study, gives a viable approach to begin the transition to full decarbonisation. Using renewable biofuels, this decarbonisation can start in 2023 with the later adoption of hydrogen as the reactive fuel when it becomes commercially viable/accessible (as opposed to NG).

A) COMPARISON WITH ALTERNATIVES
We can demonstrate that using NG in the reactive first stage, with biofuels in the secondary gasification stage, will exceed the 2035 GHG emissions target stated in the 6th Carbon Budget. For some distilleries this may be sufficient to achieve environmental policy goals/targets and this gasification solution will be a viable one to bring to market quickly (AppendixD).

Ricardo's 'Pathway to Net Zero' report for the Scotch Whisky Association highlighted a number of options for the industry to achieve carbon reduction in distilleries. Each is briefly discussed below: Several proposals for decarbonisation of distilleries are essentially improvements in thermal efficiency, e.g. geothermal heat and thermal/chemical storage. This limits such proposals to areas where geothermal heat application is viable, e.g. Scotland and so does not fit with our vision of a solution that will be marketed across the UK.

Burning Biomass – whilst this solution can work for larger distilleries, it is slow to ramp up and down in production and suffers from low efficiency, typically 60%.

Heat Pumps – the Report highlights that commercial scale demonstrator projects have not yet been implemented in the whisky sector.

Hydrogen – of all of the technologies in the SWA report, Hydrogen is highlighted as being the one with the greatest impact. Our solution is 'Hydrogen ready' but it also enables immediate carbon reduction until such time as Hydrogen is commercially viable.

No other technology progressing to phase 2 of this Green Distilleries call offers what this proposal from CCEL deliver, i.e. :
• Wholesale decarbonisation of distilleries starting in 2023;
• Minimises operating costs;
• Maintaining energy efficiency >60%, which is at least twice the overall thermal efficiency of AD bio-gas supply with an off-site AD plant;
• Hydrogen ready;
• Applicable to a variety of distilleries (inland or on the coast);
• No requirement for the capital cost of producing Hydrogen falling on the distillery;
• An ability to use Hydrogen when it is available and cost effective, with bio-oils used until then; and
• The effective use of waste draff and PAS as an essentially free fuel source.

The proposal offers a solution to the low NOx requirements of medium combustion plants (1 – 50 MW). The low NOx Hydrogen burner technology in the present proposal will be designed to achieve 100 kW burner NOx emissions of 90 mg/Nm3 (AppendixB), well inside the regulation.

B) TECHNICAL & COMMERCIAL ADVANTAGES
Gasification of biofuel is an innovative technical and commercial proposal. Our proposed solution is based on a burner design that is capable of burning bio-oils downstream of a more reactive fuel such NG, hydrogen, ethanol or a combination of these to best suit the fuel available at the site. This exceeds the 7% CO_2 reduction available via the grids planned 20% hydrogen blend.

We have provided three examples to demonstrate ways this proposal will deliver notable technical and/or commercial advantages, each augmenting each other.

Technical
• The proposed burner heated biofuel gasifier for a bio-oil/hydrogen/NG gasifier burner as the heater of a batch biofuel gasifier enables the waste draff to be used to generated 23% of the distillery energy requirement. No other proposal does this.
• The gasifier can also incorporate the use farm waste materials, e.g. barley straw. Therefore, it is a good example of decarbonising solutions that make use of circular economies (AppendixM&N). Crude glycerol (CG) will also be used so that complete low-cost decarbonisation can be achieved.
• Another major technical advantage is that NOx has been minimised through our expert engineering and innovative burner designs.
Comparison with other technical solutions is further detailed in Appendixl

Commercial
All sources of Hydrogen are currently more expensive than NG and all sources of electricity are a higher cost per unit of energy than NG. Subsequently, a major commercial advantage of this proposal is that it offers the opportunity to decarbonise and reduce costs, now, via bio-oils. Advantages include:
• It will shelter distilleries from increasing costs from an individual energy source and utilise low-cost biomass.
• Environmental impact savings can be made from using energy sources ‘on their doorstep’.
• For Whisky distillers, there is the benefit of using draff within the fuel-mix, saving the distillery the typical disposal costs.

C) SCALABILITY AND APPLICABILITY/REPLICABILITY
The technology is replicable in terms of function and type. The technology developed in phase two will be replicable to all distilleries because it is adaptable to the environment of each distillery. For example, different sized distilleries will use different burners/gasifiers, but the design principles will be validated at 350 kW and one scaled up gasifier will be demonstrated at a higher output using the same gasifier. Importantly, this will show that any distillery scale could be designed for and that this can be accomplished using the same reactive fuel supply but with a higher flow capacity gasifier heater burner.
The proposal offers a solution that is highly replicable because we are independent of any distillery. Subsequently, it is in our interests to replicate the solution at as many distilleries across the UK as possible. The proposed steam boilers will be applicable to any application of steam heat and so the technology will be easily transferable to other industrial sectors for steam heating.

D) COSTS
Capital costs will be discussed with the Partner Distillery as the project is developed at the Livingston Centre of Industrial Decarbonisation (LCID). Clearly dependent on the size of the distillery, we anticipate minimal capital costs in the order of £160k per installation, either for the steam boiler or direct fired distilleries.

In addition, there will be design, manpower costs and capital purchases of;
• Steam boiler burner conversion
• Bio-oil storage
• Control systems
• On-site hydrogen supply

Our LCID will host industry seminars to help distillers model the Opex advantages against the initial capital cost and work with them to secure funding (grant or commercial).

- Comparison to alternatives

Operating costs will be minimised. If hydrogen was used as the reactive fuel, then this may change as green hydrogen is currently expensive to produce. A carbon tax is a possible route to lowering the cost of hydrogen (UK Government Decarbonisation of Industry Strategy, 2021) but this has not been legislated for yet.

E) IMPACT ON PRODUCT QUALITY, COSTS AND OUTPUT
We will work with the few remaining direct fired distilleries to assess the impact on product quality but are confident that there will be no impact on product quality for the 98% of distilleries that are steam heated. This is because the same steam heated boiler that is presently in use will be used by the distillery.

Apart from the capital costs, this decarbonisation can be achieved with no increase in production cost and in the cost of whisky. The main route to this is the use of low-cost bio-oils and the cost-efficiency savings resultant by using waste draff.

No reduction in product output will occur as the same thermal input into the steam boiler will be achieved and the steam boiler performance will not deteriorate.

F) UNCERTAINTIES OF THE COST ESTIMATES
The future price of all fuels, including hydrogen and bio-oils is uncertain. However, a key advantage of our solution is that the primary and secondary fuels can vary with no impact on the burner. The distillery will therefore be safeguarded from future inflation in one type of fuel cost.

The demonstration study will show that the solution can be designed and operated with low NOx for Hydrogen/Hydrogen, Hydrogen/CG, ethanol/GC, Hydrogen/VO and ethanol/VO. All can be used so that any fuel price change in the future can be met by utilising the lowest cost fuel combination. Moreover, for the transition period (until hydrogen is viable), NG will be demonstrated as a viable reactive combustion fuel.

G) SITE IMPACT OF THE SOLUTION
Health & safety: As Whisky and other spirit production is a flammable substance all distilleries operate under COMAH regulations and already have all the protocols in place for the use of ethanol. Waste glycerol has methanol as a component, but the flashpoint is still high, so this is not a risk. Additional safety protocols may be introduced when the distillery migrates to Hydrogen.

Air quality: The new burner will not increase the existing NOx emissions from NG in the primary burner. The burner is specifically designed to achieve low NOx emissions (AppendixB). Bio-oils are inherently low NOx fuels due to their low GCV and low peak flame temperatures.

Fuel delivery logistic: We have already engaged alternative fuel suppliers to assure ourselves that logistics will not present challenges. Importantly, the solution operates with a variety of different fuels so users can take advantage of the best fuel mix available to their locality.

Waste disposal logistics: A reduction in local freight traffic will be achieved through the use of PA in the fuel mix. This could be especially welcome in some rural locations where the Distillery's primary egress route does not meet guidelines for heavy freight.

Production disruption: All the demonstration work will be carried out at the LCID, in the heart of the Project ACORN decarbonisation hub, centred on Grangemouth (GIDS, 2021). Fully developed and ready to be fitted, the steam boiler burner system will be delivered to the distilleries.

- Risk management & Training
Operational training in the new technology will take place at the LCID. Additionally, an industrial CPD course will be operated at the LICD on the zero-carbon technology with lectures from the University of Leeds, Colorado Construction and Distillery operators.

- Comparison to alternatives
Based on the progress of our Phase 1 trial we are confident that the solution can be deployed in early 2023. This means the decarbonisation of distilleries sites can begin in 2023, earlier than any alternative Green Distillery proposals .

H) PLANNING PERMISSIONS / ENVIRONMENTAL PERMITS
This technology will require no new planning permission or environmental permits. The technology is changing a burner and installing a gasifier which will be smaller than the steam boiler. This does not require planning permission.

The construction of bio-oil fuel tanks on the distillery site will also not require planning permission. The sites already produce a flammable liquid similar to ethanol (whisky), so no additional risk is involved in have a bio-ethanol fuel store on site. The burner will be developed to minimise NOx emissions on NG and to also have low soot and hydrocarbon emissions. All the requirements of the existing environmental permits will be met using the new staged burners with switched fuelling.

To provide supporting evidence and illustrations upload your file/s here. Please do not upload any further text in order to go beyond the word limit, it will not be assessed. Max upload size per file - 10MB Max number of files - 5

- File: CCEL - Lot 2 BatGasDW - Appendix B - Solution schematic.docx - Download

2. Long term development plan, carbon saving, dissemination and delivery of Social Value

2a. Please provide a description of your long-term development plan for your Green Distilleries solution. (10%) (applicants can use the upload link to provide supporting evidence and illustrations, any further text beyond the word limit will not be assessed) With reference to the Phase 1 Feasibility study and how the Phase 1 feasibility study has helped influence these plans, applicants are expected to: Describe the long-term development plan for the technology, further development, commercialisation, and exploitation beyond the Green Distilleries competition (15th March 2023), including a credible route to market. Describe long term plans for further development, commercialisation, exploitation post project and how this lines up with HMG's legal target to achieve Net Zero and key government policies and roadmaps such as the 10 Point Plan, 6th Carbon Budget, Energy White Paper and the Industrial Decarbonisation Strategy Explain how the project/technology supports and enables goals set out in the 10 Point Plan, 6th Carbon Budget, Energy White Paper and the Industrial Decarbonisation Strategy. Highlight the key barriers and challenges to achieving commercialisation, timescales, and estimated long term development costs, and how these will be addressed. Describe the timescale and costs of your development plan Describe the market potential/replicability of the solution and how the solution could help achieve Net Zero (Maximum 2000 words)

INTRODUCTION
We have described in our Phase 1 study that CCEL's Green Distilleries solution has been shown to be technically feasible whilst meeting the relevant industrial regulatory requirements, e.g. health and safety and air quality. This response sets out how the solution will be developed beyond TR8 to support key HMG policies and how it will create green jobs in Scotland, the Midlands and the North of England.

A) LONG TERM DEVELOPMENT PLAN
CCELs are not seeking this funding to improve efficiency at a single distillery, rather, our goal is to deliver a fully-fledged proof of concept that can be taken to market – improving decarbonisation across the distillery industry, as well as, potentially, being applicable to any industry that involves use and/or creation of steam heat.

- Technology
This is a fuel switching project, gasifing low cost Biofuels alongside distilleries' legacy fuels. It is also ready for 100% hydrogen operation when hydrogen is more widely available.

The project will demonstrate a novel biofuel gasifier and an associated reactive fuel burner. This burner will heat the gasifier to 800-1000K and supplies ~20% of the overall steam boiler 350kW thermal input. 280 kW will then be added from the biomass gasification gas (BGG), initially heated to combustion using a novel burner designed specifically to burn BGG safely. The gasification test facility will also demonstrate the performance of the at 350 kW which will show that the technology will be able to be matched to any particular size of a distillery. Additionally, there will be a demonstration of direct fired gasification in a configuration similar to that used in direct fired distilleries.

Our solution design meets HMG policy as follows:

• Ability to start to decarbonise in 2023.
• Fuel Switching to bio-oils and hydrogen when available.
• >63% GHG reductions by 2035 from 2019.
• Use of low-cost surplus wind electricity using smart meters to accept electrical power when it is lower cost than hydrogen/bio-oils.
• Green technology that can be applied to any industry using steam boilers for heat.

• Green technology that can be applied to any commercial or industrial heat application using direct fired heat.

- Further development
Some development work will be required on the fuel injection location in relation to the minimisation of NOx emissions. This centres on expertly engineering the novel reactive burner.

We will also develop BECCS for bio-oils for local CO2 removal using small scale carbon capture using a spray tower with Mono-ethanolamine (MEA) solvent. The CO2 will be recovered from the solvent using steam heating and then compressed into pressure vessel and transported for disposal at the nearby Grangmouth hydrogen hub CSS site, as per the 10PP and EWP plans for industrial decarbonisation. This was not part of the original proposal as CCS was not allowed in the funding applications.

- Commercialisation
Commercialisation will be through distillery decarbonisation CPD with live demonstration of the gasification technology on the batch-gasification test rig at the Livingston Centre for Decarbonisation of Industry (LCID).
Commercialisation of the novel biofuel gasification system will be led by patent protection of the product. Our business plan is that we will start selling the technology to the distillery industry with a first installation in September 2023 and a launch customer has been identified. Production and installation of the new gasification technology and associated fuel supply infrastructure will proceed at a rate of one distillery per month. Therefore, substantial decarbonisation of distilleries will be achieved by 2032; this aligns with HMG's 40% initial decarbonisation period in the 10PP and the EWP. A faster roll out could be achieved if there was a carbon tax introduced on fossil fuels, which is part of the Governments Decarbonisation of Industry Strategy (March 2021).

- Exploitation
By the end of the Green Distilleries competition, we intend to have a saleable biomass-based gasification solution for almost 100% decarbonisation of a distillery's production facilities. This would be achieved through the gasification of biomass, in part supported/initially heated by a reactive fuel burner that makes use of hydrogen fuel to 100% hydrogen, whilst not increasing the operating costs on the bio-oils option. During a transition period, a distillery could opt for partial decarbonisation using the same burner with NG as the reactive fuel. Due to the use of NG as the reactive fuel, this would achieve a lesser degree decarbonisation compared to if hydrogen were used as the reactive fuel. As 95% of distilleries use steam heating, the gasification solution could be applied to any application of steam boilers which are in widespread use in industry. Hence, this project could lead to substantial decarbonisation of heat in industry.

- Route to market
CCEL is already an established force in distillery construction and hence has good relations with many distillery owners and operators. The demonstrations that Lot 2 solution's technology works at the LCID, as well as the CPD training on the decarbonisation gasification technology, will be the main sales mechanism to persuade distilleries to adopt the technology. As there will be no increase in operating costs, a cost-effective solution to draff waste, and the chance to initiate circular economies regarding biomass waste, there is a ready potential market for the product.

The LCID will be designed and operated to show a working arrangement to distillery owners and managers of a set of modules combining to be a complete pilot line, leading to an early transition of distillery heat using biofuel produced from distillery by-products, feeding a low CV gas burner, connected to a gasifier furnace and steam boiler which then provides to the distillation process. The centre will include the latest audio-visual technologies to help bring the solution to life for use during seminars, client demos, BEIS presentations and even school visits (Appendix F).

In addition to this, CBS' sales channels will be used to market the technology in the following four steps: other UK spirit distilleries, other distilleries, boiler manufacturers and export.

B & C) ALIGNMENT WITH GOVERNMENT TARGETS, POLICIES AND ROADMAPS

- Net Zero
This proposal shows that an almost complete decarbonisation of the distillery industry could be possible by the end of 2032, which would be ahead of HMG's plans to achieve this by 2045.
Importantly, our proposal demonstrates how the distillery industry could lead the way on industrial decarbonisation, without waiting for green hydrogen to arrive in the gas grid (estimated in 2020 not to arrive in sufficient quantity until 2035).
CCEL's novel gasifier design supports and enables the government's goal of achieving net zero by 2045 by providing distilleries with a route to transitioning to zero carbon that provides immediate carbon savings. Indeed, our future proof solution enables distilleries to use bio-oils as fuel in the near

future, before transitioning to hydrogen as green/blue hydrogen becomes available, with no impact on the overall solution.

- 10 Point Plan Dec. 2020
Our burners have the same >90% thermal efficiency of existing steam boilers but offer the significant benefits of supporting decarbonisation and utilising low-cost bio-oils such as crude glycerol. This means that distilleries can decarbonise now whilst also being able to adapt to using the optimal mix of bio by-products / hydrogen in the future.

- 6th Carbon Budget (6CB) Nov. 2020 (accepted to be made law)
It is our understanding that GHG reduction target has now superseded that in the 10PP (from 20.4.21) and EWP. CCEL's solution supports 6CB's goal of reducing UK greenhouse gas emissions by 68% by 2035 (relative to 1990) and CCEL plans to meet more than the aimed at 63% reduction between 2023 and 2035 for the distillery industry. One of the Budget's key recommendations is encouraging businesses to take up low-carbon options. Our radically novel gasifier design can help transition distilleries to bio-fuels in the near future, and then to hydrogen. In future development BECCS will be used as advocated in the 6CB, 10PP and EWP.

- Energy White Paper (EWP) Dec. 2020
The 10PP had 180 MtCO2e (40% of the total) in the period to 2032 and the White Paper has all the 10PP and an additional 50 MtCO2e, 10 MT of which are from CCUS. Our proposal for future adoption of our design for BECSS fits in with this initiative and is achievable on the same timescale. The EWP includes new proposals on digital infrastructure and the use of smart meters for electricity. The key other development is the new UK Emissions Trading Scheme, ETS, which will enable an income to be generated from carbon reductions and hence will help to sell the present technology to the distillery industry.

- Industrial Decarbonisation Strategy (IDS) March 2021
The IDS sets out how the UK can decarbonise in-line with net zero while still remaining competitive and avoiding pushing emissions or businesses abroad. CCEL's solution supports and enables the Strategy's aim of "transforming industrial processes".
CCEL's solution is exportable, enabling the government's IDS policy aim of capitalising on "the export opportunities of having a world-leading net zero industry".

Further details regarding our solution's alignment with government targets, policies and roadmaps can be found in Appendix K.

D) KEY BARRIERS AND CHALLENGES
The key barrier to the proposed solution is the novel nature of the proposed gasification proposal and associated reactive fuel burner. This is why we propose to use some of the funding to establish the LCID. The demonstration and education facilities at LCID will enable this resistance to change to be overcome, especially when we demonstrate decarbonisation and cost reduction and a solution to waste draff.

E) TIMESCALES & COSTS OF OUR DEVELOPMENT PLAN
Our plan is based on harnessing strengths and capabilities that already exist within CCEL and its partners for this programme. This development plan is therefore made more assured because it is a market development plan, rather than a 'green-field' business development plan. Our short-term objective is the production and installation at one distillery per month, starting in 2023. At this level, the business will be profitable in the midterm and will therefore be suitable for investment to accelerate our plans.

Key to the acceleration in Scotland in 2023/2024 will be the extensive Distillery relationships that CCEL has across what is a very close-knit industry. In addition to this, CBS' sales channels will be used to market the technology in the following three steps: other UK spirit distilleries, other distilleries, boiler manufacturers.

The fourth step, most likely in 2025, will be to start exporting the technology suite. Notably, CBS has an extensive network of international clients and has previously won The Queen's Awards for Enterprise (international trade).

F) MARKET POTENTIAL/ REPLICABILITY AND HOW THE SOLUTION COULD HELP ACHIEVE NET ZERO
This proposal offers the pathway to decarbonise whisky distilleries from 2023. SWA estimates that Scottish Distilleries released 655,742 tonnes of CO2 in 2020. Crucially, this gasification proposal could work to minimise the CO2 emissions with minimal impact on operational costs.

There are about 130 (SWA) whisky distilleries currently operational, with more planned. CCEL will use

the LCID to demonstrate a route to carbon zero for all of these distilleries and for many other high energy consumption industries. The distillery industry as a whole can be a part of this demonstration process leading to carbon zero, minimising the risk of demonstrations occurring only at a single distillery.

The proposal offers a solution that is highly replicable because it can adapt to the specific needs and local environment of each individual distillery. Moreover, it should be noted that we are an independent of any distillery. Therefore, it is in our interests to replicate the solution at as many distilleries across the UK as possible.

Future expansion/market potential can be evidenced in the fact that the proposed solution will be applicable to any application of steam heat. Subsequently, the technology will be easily transferable to other industrial sectors for steam heating.

To provide supporting evidence and illustrations upload your file/s here. Please do not upload any further text in order to go beyond the word limit, it will not be assessed. Max upload size per file - 10MB Max number of files - 5

- File: CCEL - Lot 2 BatGasDW - Appendix F - The LCID.docx - Download
- File: CCEL - Lot 2 BatGasDW - Appendix K - Other solutions to decarbonisation.docx - Download

2b. Please provide figures for the estimated carbon savings generated by your Green Distilleries solution and explain the wider benefits that your Green Distilleries solution will contribute to. (10%) (applicants can use the upload link to provide supporting evidence and illustrations, any further text beyond the word limit will not be assessed) With reference to the Phase 1 Feasibility study where applicable, applicants are expected to describe the commitment your organisation will make to ensure that opportunities under the contract deliver Social Value Policy Outcomes, via the following: Estimate the potential emissions savings from the solution and provide the basis behind the calculation for your site and if replicated across the distillery sector/other industrial sectors. Please provide further justification and reasoning behind calculations used to calculate carbon savings attached as an Annex as part of your application form. Describe how the emissions savings will contribute to the UK's Net Zero by 2050 target. Provide information about job creation and other benefits generated because of the Green Distilleries proposal, including those beyond the Green Distilleries competition. Describe how the project will benefit and impact the local environment and community beyond the Green Distilleries Competition Describe how the project supports the Government's plans of "Build back better" and "levelling up" of the economy (Maximum 2000 words)

INTRODUCTION
We believe our gasification solution capable of delivering massive carbon savings for the Distillery Sector, with the potential of then being rolled out to contribute to the decarbonisation of other industries that involve the use and/or creation of steam heat. Our innovative proposal includes a timeline to carbon neutrality for the distillery sector which exceeds the timelines and objectives laid out by government i.e. the Net Zero by 2045 goal, the 6th Carbon Budget's aims and the recommendations of the Energy White Paper.

Importantly, this is not purely an environmental investment. That is to say the positive effects of the solution transcend environmental value, they have additional social and economic benefits that can be realised alongside the aim of decarbonising industry. It is an investment in economic growth and sustainability helping Britain to 'Build Back Better' whilst 'Levelling Up' the quality and long-term feasibility of our nation's industries.

A) POTENTIAL EMISSIONS SAVINGS
This proposal offers a pathway to the decarbonisation of whisky distilleries by fuel switching to the gasification of biomass/bio-oils such as crude glycerol, waste draff, biodiesel, ethanol and RVO. Partial decarbonisation could be an option in the early years of decarbonisation, using NG as the primary reactive fuel, this could then transition to hydrogen being used as the reactive fuel when it becomes commercially available.

57% of distilleries in Scotland uses NG (including CNG, LPG at 1%) as the fossil fuel [Scottish Whisky Association (SWA)]. With a GCV of 50MJ/kg this is 0.29 kg of NG per litre of whisky which emits 0.80 kgCO2 per litre of whisky (using an emissions index, EI, of 2.76 kgCO2/kgCH4 for methane). Many

distilleries in Scotland are not connected to the NG grid and use fuel oil (18% of whisky production) with a GCV of typically 43 MJ/kg and 0.33 kg of fuel oil per litre of whiskey, which will produce 1.07 kgCO2 per litre of whisky (using and EI for fuel oil of 3.24). This is an average of 0.865 kgCO2/L.

Scotland produced 778M litres of whisky in 2020 and this released 672,970 tonnes of CO2 in 2020 [SWA for 2018, 528,792 tonnes].

In 2035, 82% decarbonisation of the distillery industry is predicted to be possible to be achieved, using our business plan distillery roll-out of 12/year. This is well in excess of the target in the Sixth Carbon Budget (CCC 2020), which from 2019 – 2035 is a 63% GHG reduction target, this can be achieved by 2033 via our solution.

Details of the carbon savings are given in (CCEL-Lot 2_ BatGasDW-Q2b-Appendix_1-Calculation_of_the_GHG_Reductions.

B) CONTRIBUTION TO THE UK'S NET ZERO BY 2050 TARGET
The above analysis shows that significant reductions in CO2 emissions are possible today if waste draff is used in the gasification solution. As detailed in this proposal, this would be gasified alongside other biomass and/or bio-oils that can be broadly understood under the nomenclature biofuels. The use of biofuels will be investigated using biodiesel, waste draff and glycerine initially, as this combination will give much larger CO2 reductions.

The initial reactive fuel used for the lean burner will be NG, but the novel burner will be engineered to be hydrogen ready. Notably, even when using NG, the solution is designed to minimise the use of each said reactive fuel. Its purpose is to be used, leanly, during the initial firing of the gasification furnace. It will allow the furnace to reach a temperature where the biofuel is combustible and can be gasified. The furnace, once at heat, requires minimal input from a reactive fuel source, especially when compared to alternative proposals/methods.

CCEL's novel gasification solution supports and enables the government's goal of achieving net zero by 2045 by providing distilleries with a route to transitioning to zero carbon that provides immediate carbon savings. Our future proof solution enables distilleries to use bio by-products specific to the industry, e.g. waste draff. It also allows the incorporation of future reactive fuels – e.g. green/blue hydrogen – in the near future – with no impact on the overall solution.
Additionally, using bio-waste as fuel means it will no longer need to be removed offsite for disposal, avoiding the associated emissions.

C) JOB CREATION & OTHER BENEFITS OF THE PROPOSAL

- Job Creation Directly Resultant of this Project
Both CCEL and CBS are established industry figures. CCEL are recognised as a major employer and one of the fastest growing SMEs in Scotland with an annual turnover in excess of £20 million. We are significant employers to a range of local communities in both Scotland and the North of England.
We anticipate the creation of small division that specialises in the installation of the solution; two teams of five to ten people, dependent on the size of the works undertaken. There will also be the possibility of job creation within CCEL/CBS and our supply chain partners.

The manufacture of the proposed burners will take place in the UK. CBS, based in the North of England, will subcontract several stages of the manufacturing process e.g. the creation of the cast iron parts needed for the boilers. All subcontracted licenses will be allocated to parties that are UK based.

The most significant part of the distillery sector is located in Scotland; therefore, we believe manufacturer/installation will first focus on developing the largest swathe of the industry. Consequently, the setting will be established to then transform the innovative pockets of the distillery sector that exist throughout the UK.

Once this national stage is complete, we predict that we can begin export the technology to international markets. CCEL and CBS both have an established international presence and will leverage this to encourage growth and, consequently, the rate of job creation.

The continued success will ensure that job growth is sustainable alongside the improvement of our commercial opportunities. This project will help solidify our place in other similar markets, improving our financial standing and encouraging our continued input to local economies.

- Potential Reduced Costs & Sustainable By-Product Use Options
It has been shown earlier that the decarbonisation of this proposal can be achieved at a similar running cost to a NG fired steam boiler (though the capital costs are higher). This is because the biofuels will be lower in cost than NG or fuel oil, but the more reactive first stage hydrogen or ethanol

will be a higher cost than NG. However, these reactive fuels are only used leanly and minimally at the beginning of the process energy input and this will be balanced by the lower cost of the biofuels. As waste draff is a zero-cost process by-product fuel, it is likely that the use of this by-product will result in the running-cost being reduced further. In addition, the cost of disposal of such waste will be avoided which will further reduce the overall costs.

Critically, we do not envisage any increase in the cost of whisky, other than due to the finance costs of the capital investment to change to the gasification solution and associated lean reactive fuel burner.

- A Replicable and Exportable Technology
Our Green Distilleries solution can be part of the road map that leads British business into a competitive and sustainable future, somewhere where we export our technologies to contribute to the decarbonisation of all industry worldwide. This has potentially massive social value and economic benefits that can be realised alongside the more explicitly evidenced environmental values of the solution.

This solution does not only work towards combatting the out of the Climate Crisis. Crucially, it also proposes a manner of leveraging green export opportunities in order to realise the commercial and industrial benefits of having forward looking net zero industries.

D) HOW THE PROJECT WILL BENEFIT AND IMPACT THE LOCAL ENVIRONMENT AND COMMUNITY
ENVIRONMENTAL BENEFITS

The project will benefit the local environment in a number diverse and mutually beneficially ways:
- Using bio by-products as fuel means it will no longer need to be removed offsite for disposal, avoiding the associated emissions and their damage to the local environment, as well as enabling local distilleries to achieve additional environmental impact savings by using local/national energy sources.
- CCEL's innovative gasifier and reactive fuel burner design will enable the local community to achieve the benefits of decarbonisation immediately. This is because it does not require waiting for hydrogen to be available, as useful CO2 reductions can be achieved now using biofuel and distillery by-products such as waste draff.

LOCAL COMMUNITY BENEFITS (Social Value)

- Job Security
The project will benefit the local community by providing job security for those whose livelihoods are dependent on the distilleries. This is because CCEL's innovative solution is future proof, enabling distilleries to use biofuel and by-products as fuel in the near future before then enhancing the solution further by transitioning from the use of NG as the initial reactive fuel to the more sustainable green/blue hydrogen (when it becomes available). This transition can be achieved with no impact on the overall solution because the reactive burner will be built hydrogen ready.

- Charity Work
CCEL have a history of contributing to notable charitable projects that have a real effect as well as a national media presence. For example, we have contributed to the well-known TV Show/Project DIY SOS which is currently broadcast by the BBC. For this show, we undertook the ground works and other construction services pro-bono.
This funding and continued growth will facilitate the continuation and expansion of our charitable works.

- Contributions to Academia and Associated Industries
We can demonstrate how this project, the research conducted by UoL and the technical innovations that result from it, will offer major contribution to academia as well as industry.

Integral to this is the creation of the Livingston Centre for Industrial Decarbonisation (LCID). The LCID will be an innovation and research hub. It will give us a base through which we facilitate a route to decarbonising the whole of the distillery industry, rather than a particular distillery in the outset. It is/will be core to the process of development to decarbonisation, and core to the route to market. We are seeing, already, the keen worldwide interest in the decarbonisation of the Scottish Distillery industry and this opens up opportunities for us in international markets.

Our academic partner, the UoL, is a widely respected institution in the international community. It conducts research of the highest standard. We will present the results of our work at industrially relevant conferences and in the world leading research Journals. Additionally, a paper will be presented at the Worldwide Distilled Spirits conference, articles will be written for the Brewing and Distilling International magazine, and a further paper will be written for the European meeting on Combustion in Furnaces and Boilers.

For this project, a CPD course will be operated at the LCID site, which would include demonstrations of the decarbonised heating equipment. Our intention is to generate a new CPD course on 'decarbonisation of the distillery industry'. We would have a combination of University and industrial speakers on the course.

E) SUPPORTING "BUILD BACK BETTER" AND "LEVELLING UP"
As understood from the policy paper 'Build Back Better: our plan for growth', we believe that our proposal can deliver constructive and appliable innovations that can decarbonise the distillery sector and other steam heat involved industries. This matches the stated aim of support 'economic growth through significant investment in infrastructure, skills and innovation. Decarbonising technologies are, by their very nature, innovative and are at the heart of the sustainable infrastructure that will support continued growth into the future.

As demonstrated, above, in our 'Local Community Benefits' and 'Job Creation' sections, we believe that this proposal is in line with 'Levelling Up' policy aims. This proposal represents sustainable investment, that will lead to job growth and increased environmental value in the local communities of the UK. Specifically, decentralised areas such as Scotland and the North of England. This is particularly valuable in light of our collective recovery from the COVID-19 Pandemic, a strong sustainable recovery is in the best interests of us all.

To provide supporting evidence and illustrations upload your file/s here. Please do not upload any further text in order to go beyond the word limit, it will not be assessed. Max upload size per file - 10MB Max number of files - 5

- File: CCEL - Lot 2 BatGasDW - Q2b - Appendix 1 - Calculation of the GHG Reductions.docx - Download

2c. Please provide a description of your dissemination plan for your Green Distilleries solution. (10%) (applicants can use the upload link to provide supporting evidence and illustrations, any further text beyond the word limit will not be assessed) Applicants are expected to: Identify the relevant stakeholders, including plant manufacturers and suppliers, end users, trade bodies and academia Provide a dissemination plan, including a timetable for any dissemination activities, describing how the learnings from the demonstration study will be shared with industry. The plan should include key stakeholders, lessons learnt, and any challenges faced during delivery. Describe how the outputs of the demonstration study will be disseminated beyond the end of the Green Distilleries Competition (15th March 2023) (Maximum 1000 words)

INTRODUCTION
We subscribe to a partnering and collaboration ethos that encompasses industry and environmental stakeholders, senior management, our supply chain and subcontractors.

CCEL has grown rapidly over the last sixteen years, becoming one of the fastest growing SMEs in Scotland. This growth has been underwritten by an ethos of delivering excellence in our construction projects. The distillery industry in Scotland is particularly close knit and CCEL is already acknowledged as a key supplier to the distillery industry. Our executives have a wealth of relationships to leverage from across the industry.

A) RELEVANT STAKEHOLDERS

The stakeholder groups, thus far identified, are detailed below:
-Associated Industry Stakeholders:
• The Whisky Distillery Sector.
• The broader Distillery Sector.
• The Scotch Whisky Association (SWA), a powerful voice sitting alongside the distillery and the consumer, publicly driving the route to Carbon Zero with pressure from its customers in the wholesale markets.
-Public Body Stakeholders:
• BEIS
• Scottish Environmental Protection Agency (SEPA) and other associated public/governmental bodies, i.e. the Department for Food and Agriculture (DEFRA) and the Environment Agency (EA).
• Local Authorities and associated community groups.
-Other/Potential Stakeholders:

• Environmental charities
• Other process industries where the use of steam heat will need to be decarbonised in line with government plans.
• Universities and Further Education Colleges that seek employment, training or work/research placements for students/researchers.
• Press/ trade journals and other bodies within our stakeholder communication plan.
-Internal stakeholders:
• Colorado Construction Engineering Limited (CCEL), a specialist distillery design and installation company that act as the principal contractor/lead on this proposal. CCEL have constructed nine of the new distilleries in Scotland, from Glen Turner to InchDairnie (Fife), Kings Barns (St Andrews), and Torabhaig (Skye). A critical advantage of CCEL is that it employs a large number of qualified inhouse project management personnel, many of whom have extensive experience in the distilling industry. One of CCEL's staff will be allocated the responsibility of overseeing all activities at the Livingston Centre for Industrial Decarbonisation (LCID) as well as first mapping and then monitoring the activities of the wider stakeholder community.
• Clean Burner Systems (CBS Ltd), an innovative burner manufacturer that is a key internal stakeholder for the project.
• The University of Leeds (UoL) the third key internal stakeholder who acts as the research and development partner.

B) OUR DISSEMINATION PLAN
Please find our dissemination plan in (CCEL–Lot_2_BatGasDW-Q2c-Appendix_1–Dissemination_Plan) with further details in AppendixE.

-Key Stakeholders & Stakeholder Management
We have already begun our stakeholder analysis and will continue to identify and refine each stakeholder's relation to the proposal and in what why they are to be involved/will be affected by the proposal's development.

We will implement a communication plan to promote the success of the project via the continuous sharing of objectives and processes with project stakeholders. The agreed Communication Management Plan (CMP) will define the structure and methods of information collection, formatting and distribution. It will also make clear project team members roles regarding actions, processes and responsibilities.

-Timetable
Through the utilisation of our project management plan and project schedule, we will identify the critical path of implementation and the main stakeholders involved at each stage of the project. In the first instance, we will focus on implementing a partnership and governance structure, and clearly define the roles and responsibilities of each stakeholder.
The timetable for stakeholder management will work at three different levels:
1. We will report to our customer, BEIS, in accordance with our milestone schedule.
2. We will have a continued and ongoing communication campaign that invites delegates and potential customers/stakeholders to attend the LCID for seminars/demonstrations.
3. We will have an education campaign that will be driven by industry events (see shared learning below).

- Sharing Learnings
The project management team will follow PRINCE2 methodology. This will facilitate continuous improvement and knowledge capture/transfer at each stage-gate in the project plan.
The LCID will include the latest audio-visual technologies to help bring the solution to life for use during seminars, client demos, BEIS presentations and even school visits.
In addition to this, UoL are experienced in the dissemination of the results of research projects to industry using CPD training courses, usually of one-week duration. For this project a CPD course will be operated at the Livingston site, which would include demonstrations of the decarbonised heating equipment.

- Challenges faced during delivery
CCEL, alongside CBS and the UoL, acknowledge the necessity for developing and maintaining a healthy working relationship with all stakeholders. We hope to nurture this relationship via several avenues of collaboration, including coordination and development meetings, seminars and workshops and a "Relationship Charter".

C) DISSEMINATION THE GD COMPETITION

- Commercialisation
This programme will result in decarbonisation benefits for the whole of the industry, rather than a particular distillery in the outset. It is core to the process of development to decarbonisation, and core

to the route to market.

Our CCEL relationships and market awareness will be key in promoting our trials at LCID. The contact base extends internationally, through current ownership structures in the distillery industry. We are seeing, already, the keen worldwide interest in the decarbonisation of the Scottish Distillery industry and this opens up opportunities for us in international markets.

- Evangelisation
Our academic partner the UoL is experienced in the dissemination of the results of research projects to industry using CPD training courses, usually of one week duration. For this project, a CPD course will be operated at the LCID site, which would include demonstrations of the decarbonised heating equipment. Our intention would be to generate a new CPD course on 'decarbonisation of the distillery industry'. We would have a combination of University and industrial speakers on the course.

We will also present the results of the work at industrially relevant conferences and in the research Journals. A paper will be presented at the Worldwide Distilled Spirits conference, articles will be written for the Brewing and Distilling International magazine, and a further paper will be written for the European meeting on Combustion in Furnaces and Boilers.

To provide supporting evidence and illustrations upload your file/s here. Please do not upload any further text in order to go beyond the word limit, it will not be assessed. Max upload size per file - 10MB Max number of files - 5

- File: CCEL - Lot 2 BatGasDW - Q2c - Appendix 1 – Dissemination Plan.xlsx - Download
- File: CCEL - Lot 2 BatGasDW - Appendix E - Additional details for dissemination.docx - Download

3. Project Financing

To accompany your application you must upload the Green Distilleries Project Cost Breakdown Form here. Max upload size per file - 5MB Max number of files - 1

- File: CCEL - Lot 2 BatGasDW - Q3a - Appendix 1 - BEIS_Project_cost_breakdown_form_contracts_master_template.xlsx - Download

3a) With reference to the Phase 1 Feasibility study and how the Phase 1 Feasibility study has helped firm up these costs, applicants are expected to: Fully fill in the Green Distilleries Phase 2 project finance form. Clearly demonstrate that the project can deliver a workable solution (including the use of modelling or demonstration). Provide clear reasonings to the overheads and eligible costs Provide reasonings and justifications behind cost estimates, including any contingency and assurance planning for costs (please attach any evidence in terms of letters of support, contracts, existing agreements along with your Phase 2 application). Provide a detailed description of major cost items greater than £10,000. Justify costs and provide certainty of availability and assurance of costs provided for materials, equipment and products that are required for the Green Distilleries Phase 2 Project. BEIS normally calculates overheads as a fixed percentage of all direct labour costs at 20%, but in exceptional circumstances the overhead rate could be higher, applicants will have to justify overheads above this percentage, this must be fully detailed in the application. (Maximum 1000 words)

INTRODUCTION
We have developed a technical proposal that we believe offers exceptional value for money (VfM) for the public purse. As well as leading to cost efficient carbon reduction for the distilleries industry, ours is not a 'one site' solution and we intend to market it widely. The Social Value associated with additional employment, manufacturing and exporting is very high. It is also a cost efficient and cost certain proposal as explained below and in our associated cost breakdown (CCEL-Lot 2_BatGasDW-Q3a-BEIS_Project_cost_breakdown_form_contracts_master_template).

Substantial savings could be achieved if both projects, GD165_HyBioDDP and GD166_BatGasDW, were awarded to CCEL (see AppendixG).

A) DEMONSTRATING A WORKABLE SOLUTION
CCEL confirm that the solution is operable and workable in nature and that we will be able to demonstrate this at Livingston Centre for Industrial Decarbonisation (LCID). Crucially, this not just a modelled solution but is a practical engineering solution that will be deployed in 2022. All projected costs are backed up by firm quotes.

The technology has been demonstrated to work in our Phase 1 work at the University of Leeds. It is underpinned by extensive research and development for many years and of the highest international quality, published in the gas turbine combustion literature. As BEIS is aware from our Phase 1 progress reports, we have made exceptional progress with the project starting at TRL4/5 and projected to be TRL8 by the end of Phase 2.

The LCID will be both a test site and showcase for the new solution. This will be designed and operated to show a working arrangement to distillery owners, managers and BEIS stakeholders.

B) OVERHEADS AND ELIGIBLE COSTS
The main overheads associated with this project and for the two-year Phase 2 development period, are:
• The modification of the facilities at CCEL in Livingston to create the LCID. This offers excellent value for money for BEIS since the fabric of the centre is already in place and this represents CCEL investment in this project.
• CCEL management of the project (including H&S) and LCID fitout. Here too we have planned for additional CCEL co-investment in this project through the uncharged Project Ambassador work of our Chairman (approx. 1 day per month) and the free of charge use of our social media channels to amplify BEIS' public communication work.
• CBS – our key sub-contracting partner who will be responsible for sourcing and building all aspects of the technical solution.
• University of Leeds – our other our key sub-contracting partner who will be responsible for R&D and technical tests.

C) COSTS ESTIMATES - REASONINGS AND JUSTIFICATIONS

Cost estimates:
We have attached to this application, quotes from the two sub-contracting partners, technology and technical component suppliers and fuel suppliers. We have also provided detailed costs for our CCEL staff and a staff cost breakdown for CBS and UoL staff.

Justification:
We are fortunate that our phase 1 project is at TR4. Subsequently, we have a very good grasp on the likely costs and have already been able to undertake value engineering to ensure that they offer VfM. In addition to the co-investment mentioned above, CCEL has introduced the following cost saving measures: For Phase 1 & 2, a 20% reduction has been implemented to all daily rates as a contribution to costs.

Contingency:
We have included 10% contingency for all equipment costs.
Opportunities for Savings:
• Suppliers are cautious with their pricing when quoting for 'potential' sales at some point in the future. As part of our mobilisation activities, CCEL and its two sub-contracting partners will work to achieve discounts against the attached quotes, passing the full savings back to BEIS.
• New ways of working: As a UK team with our key sub-contracting partners being based in Leeds and Rugby we do have travel and accommodation costs. We have assumed that business will to return to pre-pandemic ways of working. However, if that is not the case then we anticipate a major reduction (>40%) in our £2.7K pm costs.
• Should the consortium be successful and awarded both Lots a further reduction of £372,000 will be implemented as a reflection of the duplication of equipment and laboratory costs.

D) MAJOR COST ITEMS
We confirm that we will use open book pricing for this project. Therefore, our costs as seen in the attached cost breakdown will be indicative of the major cost items. We will provide an updated cost breakdown report as per the agreed financial milestone regime.

Broadly, the major cost items will be understood in the following categories:
• The overhead cost associated with the building fabric required for the development of the testing/development/ showcase facility (LDC).

• Capital costs as laid out in our cost breakdown
• Operating costs as laid out in our cost breakdown

E) CERTAINTY OF AVAILABILITY AND ASSURANCE OF COSTS
We have carefully benchmarked all of our costs against other comparable sources of labour/services. Importantly, the processes that we employ provide our clients with an excellent degree of reassurance, and our openness means that we are delighted to host them for audits of our work.

To ensure transparency in our costing model by breaking down prices in great detail, we commit to open book pricing for this project. We will document and be able to supply material tickets with invoices in order to provide total transparency as to what we have bought/spent.
Cost efficiency is critical, therefore, in order to prevent the duplication of costs, we have/will undertake thorough self-checks based on materials delivered to site, hours worked and other key data, and, as stated above, we provide material tickets as proof as part of the invoice. We prevent duplication of invoicing by carefully tracking all works and registering invoices for them, and meticulously keeping track of when these have been sent.

F) OVERHEAD RATE
CCEL have calculated overheads as a fixed percentage of all Unit Labour Costs (ONS definition) at 20%. We have benchmarked our key subcontractors to ensure that they are offering VfM when compared with their industry peers.

To provide supporting evidence and illustrations upload your file/s here. Please do not upload any further text in order to go beyond the word limit, it will not be assessed. Max upload size per file - 10MB Max number of files - 5

- File: CCEL - Lot 2 BatGasDW - Q3a - Appendix 2 - Supporting Evidence.pdf - Download
- File: CCEL - Lot 2 BatGasDW - Q3a - Appendix 3 - Letter of Support.docx - Download
- File: CCEL - Lot 2 BatGasDW - Appendix G - Synergy Opportunities Lot 1 and Lot 2.docx - Download

3b) Value for money to HM Government - Please describe how your Green Distilleries solution represents good value for money for HM Government. (15%) (applicants can use the upload link to provide supporting evidence and illustrations, any further text beyond the word limit will not be assessed) Applicants are expected to: Provide evidence for the additionality achieved with this funding. Demonstrate a fair balance of risk and benefits for BEIS, including no element of profit in the project costs. Describe why the proposal represents good value for money for HM Government, where costs are realistic and justified and are likely to secure the expected project aims and deliverables, including the selection and costing of suppliers and subcontractors. The answer should explain the following: How the availability of public funding makes a material difference to the actuality and pace of moving the solution towards commercialisation, and Qualify and quantify the savings that are being passed on to HM Government to reflect the asymmetric balance of risks and benefits accruing to the project consortium and HM Government. (please refer to Risk-Benefits sharing Section 4 (10) of this application guidance form). As part of the assessment process for Phase 2, project teams will be asked to clearly state, where cost savings are being provided compared to exclusive development contracts. These cost savings form part of the eligibility conditions for the Competition, i.e. projects that do not offer justified cost savings will not be eligible for Phase 2 funding. (Maximum 1000 words)

INTRODUCTION
Our Green Distilleries gasification solution will represent good VfM for BEIS in both the short and long term. Crucially, our proposal fits the ONS methodology for demonstrating VfM.

The dynamism, replicability and broad appeal of our proposal is supported by considerable evidence and, we believe, will mark our proposal as a standout in terms of VfM, practicality/viability, and equity.

A) ADDITIONALITY ACHIEVED WITH THIS FUNDING
We understand additionality to be the extent to which something happens as a result of an intervention that would not have occurred in its absence. We also understand that the aim of this funding is to achieve a desired outcome, i.e. to fund a feasible solution which facilitates the decarbonisation of the distillery sector in order to fulfil wider policy aims regarding carbon neutrality whilst simultaneously developing a robust carbon zero industry.

We can demonstrate that this funding will allow us to fully develop innovative technologies which have the capacity to transcend the distillery sector.

-Decarbonising Now
This proposal can help transition today's fired and steam heated distillery operations to biofuels in the near future, as well as offering further future carbon savings by making the reactive burner hydrogen ready. This means that the lean burner, used only at the start of the gasification process, can make use of green/blue hydrogen rather than NG when it becomes available.

We offer an immediate route that initiates the transition to a zero-carbon economy, with immediate carbon savings beginning from 2023. No other technology in this Green Distilleries call (or in the literature) offers what this proposal will deliver. This demonstrates – concretely – the additionality that would be achieved by the funding of our proposal.

We believe the funding of this proposal will contribute to the fulfilment of government policies/targets that relate to carbon emissions and the climate emergency. For example, this includes Net Zero 2050, the 6th Carbon Budget and the Industrial Decarbonisation Strategy. Please see 2a for a breakdown of how our solution contributes to said plans.

-An Equitable Solution
We are independent of any distillery; it is, therefore, in our interests to replicate the solution at as many distilleries across the UK as possible. Crucially, we have the proven route to market and the facilities at CCEL that will be swiftly adapted to create the Livingston Centre for Industrial Decarbonisation (LCID). The proposal offers a solution that is equitable, demonstrating the additionality and VfM achieved by working to decarbonise the whole sector rather than only specific parts of it.

The additionality is further demonstrated when the potential of this solution transcends the scope of the distillery sector, i.e. any industry that involves the use and/or creation of steam heat.

B) BALANCE OF RISK AND BENEFITS FOR BEIS
The risk is fairly balanced in that our plans do not include any element of profit and the entire distillery sector will benefit when we are successful. Furthermore, LCID will benefit the decarbonisation industry by being a centre that can be used by the industry for seminars, meetings etc. It is in CCEL's interest to create a feasible solution that goes to market. Not to do so would result in the annulment of over 2 years of work, labour resources and research.
We have committed to a full dissemination plan to ensure that lessons learned and other outputs are shared widely and publicly.

C) VALUE FOR MONEY FOR HMG
The National Audit Office uses three criteria to assess the VfM of spending. These are Economy (spending less), Efficiency (spending well), and Effectiveness (spending wisely).

-VfM Methodology
CCEL understands that the concept of value relies on the relationship between resources and being able to satisfy many differing needs, the fewer resources used and the greater the satisfaction of needs, the greater the value.

Below, we have detailed how our proposal offers VfM as it relates to the categories of VfM laid out by the NAO:
• Economy: Our proposal, through its use of low-cost biofuels and distillery by-products, is both cost-effective and cost-saving compared to current technologies.
• A major commercial advantage of this proposal is that it offers the opportunity to decarbonate now via bio-oils. Bio-oil producers are close to many distilleries, so the supply of bio-oils is assured. As the automotive industry transitions to electric vehicles, the demand for automotive biofuels will fall and producers will be looking for new markets.
• Efficiency: We will capture lessons regarding particular approaches that improve efficiency, reduce costs and increase value. Value engineering is a continuous process, which will be undertaken throughout the project by the whole. We will also perform regular cost and risk reviews in-line with the project's established governance procedures.
• Effectiveness: We can demonstrate that the gasification solution will achieve a major reduction in GHG emissions. For some distilleries, this may be sufficient to achieve environmental policy goals/targets and this product will be the easiest to bring to market quickly. No reduction in product output will occur as the same thermal input into the steam boiler will be achieved and the steam boiler performance will not deteriorate.

- Availability of funding will make a material difference
The production of the gasification test rigs in the Phase 2 is projected to be over £1M in equipment and

construction costs which could not be funded by industry. Subsequently, this public investment is essential if these large-scale trials on decarbonisation using biomass gasification are to go ahead. Once the method has been demonstrated to be viable, industry will bring the product to market as reduction in carbon emissions is a priority in the industry at present.

- Expected savings
It is CCEL's intention to create a marketable solution for the entire industry. Our worst scenario business plan assumes installation at one distillery per month. If we use the Scottish Whisky Association budget assumptions of £4m per distillery then the first five years' VAT paid to HMG is forecast to be £48m.

4. Project delivery and teams

4a. Project team and Organisation – Please provide a description of your project team and organisation for the Green Distilleries Phase 2 Demonstration Study. (10%) (Please attach any CVs to the application prior to submission) (applicants can use the upload link to provide supporting evidence and illustrations, any further text beyond the word limit will not be assessed) Applicants are expected to: Identify the skills and competencies necessary for each task. Provide an organogram mapping skills, competencies, roles, and responsibilities (including percentage of overall time that key members will be dedicating to the project). Outline the key roles for each partner and the proposed governance arrangements between the partners to ensure effective project delivery. List any external parties responsible for delivering goods or services worth more than 10% of the total project value and explain how they will ensure that these parts of the project do not give rise to delays in the delivery of the project. Guarantee access to any necessary specialist facilities, operational knowledge and skills, or other resources required to execute the project. Provide details of the relevant skills, qualifications, and experience of main project team members including descriptions and evidence of previous relevant work carried out. Include brief details of relevant previous projects, including the date, location, client and project size. Provide brief CVs of lead individuals within the project team in an Appendix to the Application (CVs should be no longer than 2 pages each). Have a strong delivery team with proven experience of successfully delivering comparable projects. (Maximum 2000 words)

A) Skills and competencies necessary for each task
We have determined via our Phase 1 trials that our Green Distilleries solution is technically feasible and has the potential to meet the relevant industrial regulatory requirements. This includes H&S and air quality.

We have also assembled a team that has all of the necessary skills and competences to achieve all of our Phase 2 goals. This includes scientific resources from the University of Leeds (UoL), technical engineering staff from Clean Burner Systems (CBS), excellent Project Management and Health and Safety staff from Colorado Construction & Engineering Ltd (CCEL), and a number of specialist sub-contractors and technology suppliers.

UoL have invented the decarbonising distillery gasifier that will be used in our proof of concept.

CCEL will provide and fitout the Livingston Centre of Industrial Decarbonisation (LCID) and will be the lead organisation/co-ordinator for the project. CCEL also have the Distillery domain expertise necessary to help embed our successful decarbonisation solution into the Scottish Distillery industry.

CBS will manufacture the new gasifier and burners and be the primary route to market, nationally and Internationally, in the dissemination phase. CBS have demonstrable experience of helping to prove the viability of innovative burner technologies and then taking them to market. For example, their Nu-phalt™ Thermal Patching system is in use by over 30 councils across the UK and has won them a Queen's Awards for Enterprise (international trade).

Our approach to successful project management and project delivery, including regular training and upskilling, is described in detail as part of our response to question 4b Project Plan.

The required skills/competencies of our project team are described in section F) Our Project Team.

B) ORGANOGRAM

Please see our suggested project organisation & governance model in (CCEL - Lot 2 BatGasDW - Q4a - Appendix 1 - Organogram). Details of the project team members are provided in section F) of this response. Please see (CCEL - Lot 2 BatGasDW - Q4a - Appendix 2 - Project dedication) for the percentage of time of key members dedicated to the project.

C) PARTNER GOVERNANCE STRUCTURE
Colorado Ltd (CCEL) will be the lead organisation/co-ordinator for the project, with CBS Ltd (CBS) and the University of Leeds (UoL) as key subcontractors.

CCEL is a renowned Scottish engineering and construction contractor, with a specialisation in the design and build of distilleries and visitor centres. The company has constructed or expanded ten distilleries and has undertaken M&E work at another 30 distilleries. The business carries out works for distilleries throughout Scotland and Scottish Isles. Subsequently, they have built up extensive experience and relationships in the sector.

CBS manufactures gas burners for gas fires. Notably, the company is now the markets' principal supplier for Europe and North America, having recently added the manufacturing of the entire Bekaert gas fire burner range to its production facility in Rugby. This product know-how and expertise provides an excellent base for developing the biofuel gasifier and associated reactive fuel burner.

UoL is one of the UK's largest Universities with a turnover of £674M and a research income of £131M, including £19.25M of UK Government contracts which it is used to managing. The University has one of the UK's largest Engineering Faculties with a 112-year background in energy research, most of it housed within the School of Chemical and Process Engineering. The new £12M Energy Building will house some of the R&D work for this project. An 84-year research relationship with British Gas concentrated on the performance of NG burners in industrial and domestic processes. The team at UoL has 38 years' experience in low NOx burners for process heat and gas turbines. Eight industrial gas turbine companies use the radial swirlers developed by Prof. Andrews.

D) SUPPLY CHAIN
Notably, CBS will fabricate and manufacture the prototype gasifier for the Phase 2 project as well as the novel reactive burner. This gasifier can then later be used and adapted by external manufacturers for the commercial roll-out.

The boiler for the demonstration rig will be supplied by Byworth Boilers, a UK manufacturer of industrial steam and hot water boilers to the international distillery industry. CBS have a longstanding relationship with Byworth. For contingency purposes, we are also in discussions with Cochran UK, internationally renowned boiler specialists who have been manufacturing, supplying and maintaining industrial boilers for 135+ years.

Our hydrogen supply and storage supplier is BOC. They are the UK & Ireland's largest provider of industrial, welding and specialist gases. Argent Energy, the UK's premier biodiesel provider, were our key suppliers during Phase 1. They will supply us with bio-glycerine in Phase 2.

We are also in discussions with INEOS in Grangemouth for the supply of ethanol. Logan Energy will be our supplier of alternative fuel.

For the supply of biomass, and other assorted materials used in the gasification process, we will source materials from existing national suppliers, e.g. those that supply low-cost wood chips and agricultural products such as straw. This ensures that for Phase 2 we will make use of sustainable providers of materials that already exist on the market.

UoL has an exceptionally broad supply chain that we can call on for products such as the HORIBA HOR IDA testing equipment.

Robust supply chain management, in line with ISO 9001, will ensure that goods or services more than 10% of the project value will not give rise to delays in the delivery of the project.

E) ACCESS TO SPECIALIST RESOURCES
Our team has already been mobilised with the necessary resources to achieve the objectives of the phase 2 project. Namely, we have UoL, who are experts in combustion technology; CBS who have been part of the UK gas burner market for over thirty years; and CCEL, who have the domain expertise in distilleries and a proven track record of managing major construction and M&E programmes.

As long-established organisations – known and considered to have excellent reputations in the industry – CCEL, CBS and UoL will enable access to any necessary specialist facilities, operational knowledge and skills, or other resources required to execute this project.

F) OUR PROJECT TEAM

- Key team members, their role, skills & experience

[This information has been redacted]

G) CVs
Please see appendices of the key project team members attached to this response.

H) DELIVERY EXPERIENCE
The Colorado Group has exceptional experience in the distilling and brewing industries. We are proud of our growing reputation in the whisky sector and have undertaken projects with clients who include – North British Distillers, InBev, Chivas, Glen Moray Distillery, Speyside Cooperage, Kingsbarns Company of Distillers, Glen Turner Distillery, Mossburn Distillers, and The Raasay and Borders Distilling Co. In 2013 we won the Business Insider Magazine award for the fastest growing SME in Scotland.

Recent work includes the £35M Glen Turner Distillery project, which produces 25M litres of whisky per

year, was assessed by the Scottish Construction Centre as an example of ‘best practice’ of construction procurement. The award was based on the level of savings that were delivered by the Colorado team, while constructing the project as the design was developed.

Our solution is based on the installation of our gasification solution and reactive fuel burner into the distilleries’ existing infrastructure. CCEL have an excellent track record of working on live production sites. For example, CCEL were recently appointed by John Fergus and Co. to construct their new £7 million distillery, offices and warehousing in Glenrothes. The additional development is set within the existing recently completed operational whisky distillery production and storage facility a Lower Tier COMAH site. Colorado undertook the role of Principal Designer and Principal Contractor working closely with the client to ensure all risk was reduced to as low as reasonably practicable.

CBS have been part of the UK gas burner market for over thirty years, having been involved in the design of premix industrial gas burners as far back as the late 1970s/early 1980s. CBS have developed everything from large industrial burners to small gas fire burners. Furthermore, they were responsible for the development of the Nu-Phalt Thermal Repair system for Highways, which has been taken up by over 50 local authorities. Their ability to take products from CBS’ core business and harness them to create new products and services demonstrates their capacity for innovation.

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4b. Project Plan - Please provide a project plan for your Green Distilleries Phase 2 Demonstration Study, including any work packages and milestones. (10%) (applicants can use the upload link to provide supporting evidence and illustrations, any further text beyond the word limit will not be assessed) Applicants are expected to: Complete Table 4a (project work packages), outlining in detail the key work packages for Phase 2. Complete Table 4b (project milestone and deliverables), outlining the project milestone and associated deliverables for Phase 2. Download the excel spreadsheets through the link below. Once you have completed the forms please save it locally. The tables can then be uploaded using 'choose file' option after the question box. Table 4a - Project Work Packages Table 4b - Project Milestones and Deliverables Present a well thought-out, robust, credible, project plans. Provide a detailed plan to include any contingency planning for risks, costs, time and resources. Provide a separate high-level Gantt chart or outline project plan listing the key tasks and timescales. Provide stage gate review points in the project life that captures key project milestones/risks. (Maximum 2000 words)

INTRODUCTION
CCEL is a renowned Scottish engineering and construction contractor, with a specialisation in the design and build of distilleries and visitor centres. The company has constructed or expanded ten distilleries, works for distilleries throughout Scotland and Scottish Isles and has built up extensive experience and relationships in the sector.

CCEL will design, build and host the Centre of Industrial Decarbonisation in Livingston (LCID) where the project will be located and will be the lead organisation/co-ordinator for the project. Key partners are the University of Leeds (UoL) who invented the decarbonising biofuel gasifier and associated

reactive fuel burner to be used and CBS who will manufacture the new gasifier and burners and be the primary route to market in the dissemination phase.

OVERVIEW & OUR APPROACH TO PROJECT MANAGEMENT

Key deliverables of the project will be as follows:
• A new gasification burner and the gasification furnace designed with a capacity of one batch filling of biomass to operate for one firing cycle on the distillery.
• A mechanism to remotely upload another biomass batch.
• A control system around maximising the CO in the gas from the gasifier and the air inlet mass flow to change the equivalence ratio.
• A hot gas transfer system to the steam boiler or direct fired distillery and a new burner to add secondary air and burn the gasified gas
• An operational LCID with gasifier, burner and steam boiler test facilities

- Project Management Methodology
During decision making throughout Phase 2 – as informed by PRINCE2 – we will consider the following project level tolerances:
• Scope
• Timescale
• Risk
• Quality
• Benefits
• Cost

These tolerances will be managed in-line with PRINCE2's seven core principles: continued business justification; learning from experience; defining roles and responsibilities; managing the project by stages; managing by exception; focusing on product requirements (decarbonisation); and tailoring the solution to the end project environment (distilleries).

Over the course of the project, we will create and maintain several key management documents. These will include the following: project brief; a business case; a communications plan; an issues register; a lessons log; and a risk register.

- Project team
Our project team is described in detail in our response to question 4a of this procurement and the attached CVs to question 4a.

We will have a sufficient number of adequately qualified and experienced staff to ensure that the service is provided to the required standards and within the target timescales.

A forward view of resource availability will avoid project disruption and mitigates its impact by the deployment of alternative resources identified at the planning stage. The PM has the experience and technical background to determine the skillsets necessary, so that he can appoint the most appropriate person to any given task. Keeping a resource management plan, the PM is always informed on resource capability and availability.

- Team skills, qualifications and expertise
We are committed to creating and maintaining a high-performing workforce. We consider our employees our most valuable asset, and therefore put the time into developing their skills and knowledge base.
All our staff will be subject to regular performance and training reviews, to ensure that their skills levels are being maintained. Resource gaps will be addressed by upskilling existing staff, utilising approved local subcontractors with the appropriate skillsets and conducting local recruitment. As a contingency, we work with our recruitment partners to identify experienced and vetted agency/temporary staff to fill vacancies.

- Monitoring & reporting
CCEL will assign an overall Project Manager (PM), who will organise weekly progress meetings with our partners and report on the project's status to the CCEL Steering Board and to BEIS at regular intervals, to be agreed upon during mobilisation.

The Steering Board will keep the focus of the work on achieving a working biofuel gasifier and associated reactive fuel burner for demonstration to potential distillery customers before the end of the [This information has been redacted]

Regular progress meetings will monitor the progress of project, milestones, key risks and mitigations as well as recommendations for improvements and innovation to achieve cost savings. We will report on each milestone detailed below, in the 'Milestones' subsection.

During mobilisation, we will hold an internal risk workshop to assess and further agree a risk management strategy and reporting procedures.

Consistent reporting will ensure that all relevant parties have access to the most up-to-date project information and will allow for inconsistencies or issues to be identified early and dealt with accordingly. All reports will be made available via MS Teams, to all authorised staff members.

- Communication
CCEL will develop a communication plan to share progress with project stakeholders. It will make clear project team members' roles regarding actions and processes necessary to maintain continuous and open communication. Communication methods will include email, phone calls, and meetings.

- Risk/Quality Management
Our approach to risk & quality management has been described in question 4c. A large part of the Phase 2 testing will be carried out by CCEL which operates a very strict Health and Safety policy. The UoL research staff will assist in the testing.

- Quality Management
CCEL is committed to providing services at the highest quality standards and has a QMS that adheres to the structure and controls of ISO 9001 and ISO 45001 Health & Safety.

- Continuous Improvement
Ensuring continuous improvement during the project, as it develops, is of the utmost importance to us; subsequently, it will be central to our approach to project management.

We will create a Continuous Improvement and Innovation (CI&I) plan during the mobilisation period of Phase 2 and to be reviewed regularly thereafter. The CI&I reviews will track the progress of the project, review the environmental/commercial benefits and provide a forum through which new innovations can be presented and refined.

SUGGESTED PHASES, PACKAGES & MILESTONES
We will conduct a phased approach as outlined below. Depending on requirements, CCEL will use Prince 2 and Agile Methodology as industry-recognised methodologies to manage all project delivery.

During mobilisation, we will further refine and mutually agree the attached detailed project plan with all key partners, to mobilise their resources to successfully deliver the project.

- Mobilisation
Mobilisation is an important aspect of project management that will underpin the success of the project and its on time and in budget achievement of all milestones.

Based on the designs developed in phase 1, the phase 2 mobilisation will comprise - placing of orders with the chosen solution component suppliers, the finalisation of the design of LCID and the start of fitting out work. This, then, leads us up to the commissioning stage of the project, which aims to manufacture the solution & upscale the programme and allow the project to go through the third phase, the proving stage, so as to become actionable/be rolled out into relevant industries.

Our route to market is that we will have a decarbonisation solution for distilleries by 2023. Initial rollout will be gradual until the event that the technologies feasibility and success in a working environment is undeniable. The proving stage of Phase 2 is a crucial aspect of ensuring the project is a success.

- Delivery Milestones
The current project development and testing plan can be overviewed in terms of below listed tasks & milestones.

The project has four key milestones:
1. Mobilisation Complete
2. Commissioning Complete
3. Proof of Concept Complete
4. Readiness for Go To Market

We have structured the milestones and project plans to first prove the full viability of the indirect (boiler) solution and then move to the direct firing tasks, however, if the BEIS team would prefer, we can run the

two in parallel.

We propose to hold a stage gate review with the BEIS team at the completion of each key milestone.

Additionally, we have listed below reporting & payment milestones. These will in average occur every two months.

• Fitting out the LCID: The first milestone, during mobilisation, is to redevelop and prepare the LCID site so that it can become a testing, development and demonstration centre.
• Manufacturing the solution components: Gasifier, burners and boiler manufacturing, Control room including heated Horiba gas analysis system, Bio-fuel storage tanks and fuel feed transfer for the gasifier.
• Installation of the gasifier and burner test rigs (will be used for demonstrations of the technology to the whole distillery market).
• Test Fitting of burner and air heat exchanger system to steam boiler and test on air only.
• Commissioning of gasifier, burner system and boiler.
• Test operate the primary combustion gasifier burner.
• Steam boiler integration.
• Optimise the gasifier for thermal efficiency. This stage reflects the refinement and finessing of the product so as to achieve quality operative ability and environmental efficiency.
• Operation of the gasifier on different bio-fuels, fed into steam boiler. The following bio-fuels will be tested: Draff, Crude Glycerol, Barley Straw, UCO, UCOME, mixed biofuels.

We will then move to the Direct Firing tasks
• Commission the direct fired burner test facility on a range of bio-fuels.
• Testing of the direct firing using a representative range of bio-fuels

A key process risk is the optimisation of the thermal efficiency of the gasifier and the development of control systems to operate the gasifier at the optimum equivalence ratio, but the demonstrated pilot scale optimum efficiencies of 70% look reliable.

This proposal will enable complete decarbonisation of distilleries and enable a start on this from the end of this project. Until hydrogen is available through the grid or from wind farms via electrolysis, NG or crude ethanol will be a transition fuel for the burner that heats the gasifier. As most distilleries use steam boilers for indirect heating of the distillery, the work will be carried out on a new dedicated burner, gasifier and steam boiler test facility at the LCID. This will enable a working package of burner/gasifier/boiler combination to be developed off-site for any distillery and this will minimise distillery production interruption, that would be entailed if the work was carried out at a working distillery.

- Route to Market / Dissemination
LCID will be designed and operated to show a working arrangement to distillery owners and managers of a set of modules combining to be a complete pilot line, leading to an early transition of distillery heat using bio fuel produced from distillery waste, feeding a low CV gas burner, connected to a steam boiler, providing energy to the distillation process. The pilot line will take into account the diverse range of distillery and local waste that can be gasified, ranging from distillery Draff to bales of Barley straw sourced from local farmers.

The decarbonisation of steam production will be available for any steam boiler process industry application, and we will work with our steam boiler suppliers to exploit this wider market, from brewing to food processing to hotels and public buildings to name but a few of our customer industries.

Please see our responses in Question 1a, 1b, and 2c for an in depth look at our proposed Route to Market vision.

A) TABLE 4A - see separate appendix.
B) TABLE 4B - see separate appendix.
C), D) and E) - Detailed Project Plan / GANTT chart - see separate appendix.

F) Stage Gate Review Points
We suggest having stage gate reviews at the end of each key milestone described above.

To complete question on Project Plans you must upload Table 4a (project work packages) and Table 4b (project milestone and deliverables) here. And to provide supporting evidence and illustrations upload your file/s here. Please do not upload any further text in order to go beyond the word limit, it will not be assessed. Max upload size per file - 10MB Max number of files - 5

- File: CCEL - Lot 2 BatGasDW - Q4b Table_4a__Project_Work_Packages__Phase_2.xlsx - Download
- File: CCEL - Lot 2 BatGasDW - Q4b Table 4b - Project milestones Phase 2.xlsx - Download
- File: CCEL - Lot 2 BatGasDW - Q4b - Appendix 1 - GANTT chart.docx - Download

4c. Project Risks – Please complete a risk register (table 4c) and provide a description of the risks and risk mitigations for your Green Distilleries Phase 2 Demonstration Study. (5%) (applicants can use the upload link to provide supporting evidence and illustrations, any further text beyond the word limit will not be assessed) Applicants are expected to: Complete Table 4c (risks and risk management) outlining key project risk register for the Phase 2 Demonstration Studies, identifying key risks and providing suitable mitigation strategies. This should also include contingency planning. Download the excel spreadsheet through the link below. Once you have completed the form please save it locally. The table can then be uploaded using 'choose file' option after the question box. Table 4c - Risks and Risk Management - Phase 2 Show a realistic and robust approach to risk management. Justify and provide reasoning to the risks and mitigation actions identified (Max 1500 Words)

INTRODUCTION
CCEL and CBS' corporate strategy is to benefit the environment through efficient construction, process plant design and low emission gasifier and burner design.

Notably, CCEL has exceptional experience in the distilling and brewing industries. For example, in the last five years alone, CCEL has constructed or expanded 10 distilleries and have carried out works for distilleries throughout Scotland. Subsequently, we have extensive experience within the sector and have cultivated a number of strategic relationships within the industry.

CBS is a leading manufacturer of gas burners and components for commercial and industrial operations. CCEL and CBS are together playing a leading role in helping BEIS deliver on the goals of the Hy4Heat programme, developing low NOx hydrogen burners (3 contracts).

Both companies follow ISO 9001, ISO 45001 and ISO 14001 principles, or are certified, which underlines our commitment to highest service quality.

A) RISK REGISTER
Please see attached appendix Table 4c.

B) OUR APPROACH TO RISK MANAGEMENT
The scope of this project encompasses four complementary risk management schemes aligned to the phases of the programme:
• design & development,
• manufacture,
• mechanical & electrical integration of the technical solution,
• and go to market/ dissemination risks.

- Design & Development
During the development/invention stage, UoL will employ a robust peer review process that requires the signoff of drawings, the original modelling and proposed technical solution.
A detailed risk assessment will be prepared and reviewed by a dedicated safety team for all aspects of the development /experimental work. In parallel, an additional detailed risk assessment of the heater function and storage of all fuels also be prepared and will be reviewed by a dedicated safety team Led by [redacted] from the University of Leeds. He is a specialist in explosion and fire safety, including the safety hazards of hydrogen. He is the main co-ordinator of the technical link between DNV GL and UoL on explosion safety. He is course director for Leeds's CPD industrial training in explosion mitigation.

- Manufacture
Distilleries are high risk sites, and so fall under The Control of Major Accident Hazards (COMAH)

Regulations. Therefore, it is paramount that all elements are meticulously tried and tested, and risks mitigated.

We will employ factory acceptance testing on all test gasifier and burner components prior to dispatching them to the demonstration area at LCID. As part of the ISO 9001 quality process, we will perform checks at each stage, starting with quality checks when the materials arrive, all the way through to a final quality sign off of the finished product. We will record all relevant information, including the materials the gasifier or burner consists of who built it, and when it was built, which provides full traceability.

The finished gasifier and burner will require independent third-party accreditation, most likely by BSI. At this stage we are planning on the basis that it will need to comply with the guidance set out in PAS 4444:2020 (hydrogen-fired gas appliances) and CBS is working with the accreditation body to discuss if any additional accreditation will be required. It will also need to achieve a UKCA mark (which is replacing the CE mark as of January 2022).

- Mechanical & electrical integration
Risk register & Risk Assessment Method Statements (RAMS)
CCEL understand that a robust risk management strategy is essential to the successful delivery of any project but especially to large construction & research projects. We follow the standard HSG approach to risk management, which is as follows:
• Plan: we will determine our implementation plan,
• Do: we will profile all identified risks, ensure appropriate mitigation measures are in place, and implement our plan,
• Check: we will measure our performance by conducting monitoring before events and investigating after them,
• Act: we will review our performance and act on all lessons learned.

- Marketing
Strong potential go to market and dissemination risks and how we will manage them are explained in the Dissemination Plan (2c).

-Risk allocations & reporting
During mobilisation, CCEL will hold a Risk Workshop with its partners CBS and the University of Leeds to agree upon an overarching risk management strategy and risk reporting procedures. Aligning our risk management system to ISO 31000 provides a structured framework for the appropriate scoring and prioritisation of risks identified. We will achieve this by scoring each risk on the following parameters:
• Risks & suggested mitigations,
• Impact,
• Probability and impact before mitigation,
• Probability & impact after mitigation.

We will create a series of comprehensive RAMS, held in a central repository, that set out precisely how we will mitigate project risks to carry out activities in the safest possible manner.
• Health & Safety: this will ensure compliance with our integrated H&S, Environmental and Quality (HSEQ) management system.
• Compliance: this will ensure that we have identified and comply with all local and regional regulations.
• Environmental impacts: this will ensure that we understand the effects of our solution on the local environment and how we can mitigate any risks. This register will also cover the environmental lifecycle of equipment and how we can dispose of equipment that has reached the end of its useful life as sustainably as possible.
• Business risk: this will cover issues including, but not limited to, employee retention, competitors, potential risks to our reputation/image, internal communication, and financial performance.

To monitor these areas, we will create an objectives log; we will assess the inputs and outputs of this log during project team meetings and management meetings. We will implement business modelling regarding how we will promote, develop, and assess the impacts undertaken throughout the project. Each risk will be allocated to a specific owner. This ensures that everyone involved in the project understands their responsibilities, and that no individual risk can be neglected. These risk allocations will be documented in the RAMS and closely monitored. Risks and their respective mitigations will be reviewed and updated regularly. The risk register will be held on a shared server, accessible to all project members and authorised BEIS representatives.

Risks will be discussed and captured in the following forums:
• Project team meetings (weekly),
• Project Steering Committee meetings (monthly),

• Management meetings with the Authority and relevant stakeholders (every 3 months),
• Internal auditing processes (monthly).

Health & safety (H&S) Risks
CCEL have two full-time H&S Practitioners who, throughout the project, will ensure compliance with our integrated H&S, Environmental and Quality (HSEQ) management system. They will be responsible for organising suitable auditing, inspections and training, and will investigate the outputs of all audits and inspections in order to address any issues or opportunities for improvement.
Having two full time H&S Practitioners instead of relying on consultants is one of the ways in which we sustainably embed risk management into the business, ensuring that it is a continuous process.
Quality Assurance (QA) plan
The Project Manager will be responsible for delivery of a comprehensive ISO 9001 backed QA plan for the full project. This will be in line with CCEL's QA policy, and the PM will be responsible, along with the WP leaders, for ensuring compliance with this throughout the project. QA processes such as reviews, independent checks and audits will be applied to the planning, design, technical oversight and monitoring activities.

In addition to QA on the process, there will be formal QA of all deliverables. QA will be an ongoing activity by our technical experts and project manager as they guide, review and monitor the progress of the project.

C) REASONING
Our reasoning for all identified risks is to avoid and mitigate the potential of any severe adverse effects both to the success of the project and the health & safety of everybody involved.
In the light of this, a large part of the Phase 2 testing will be carried out at CCEL which operates a very strict Health and Safety policy, in line with ISO 45001.

Emissions testing to be carried out during design and development phases will be conducted with certified analysers according to the latest MCERT standard. This will ensure a consistent measurement methodology with respect to the final certification phase.

Detailed reasoning for identified risks are integrated into our risk log, which is attached.

To complete question on Project Plans you must upload Table 4c (Risks and Risk Management) here. And to provide supporting evidence and illustrations upload your file/s here. Please do not upload any further text in order to go beyond the word limit, it will not be assessed. Max upload size per file - 10MB Max number of files - 5

- File: CCEL - Lot 2 BatGasDW - Q4c Table 4c - Risks and Risk Management Phase 2.xlsx - Download

Collaborative Application

Is this a collaborative application? If yes you will be asked to provide contact and organisation details for each partner.

No

Programme Performance Indicators and Benefits

How would you describe the nature of your innovation project?

Product Development

State how many FTE jobs could be retained in your organisation as a result of participation in this project? (enter a number)

4

State how many FTE jobs could be created in your organisation as a result of participation in this project? (enter a number)

12

What is the number of Partner Organisations supported to deliver the project? (enter a number)

2

Technology Readiness Level at Project Start

	1	2	3	4	5	6	7	8	9
				X					

Expected Technology Readiness Level at Project Close

	1	2	3	4	5	6	7	8	9
								X	

The Green Distilleries Competition will aim to realise the following benefits. Please select which benefits your innovation could potentially contribute to.

	Yes	No
Further understanding of technical feasibility of fuel switching/ enabling technologies	X	
Successfully demonstrate fuel switching/enabling technologies	X	
Develop industry and market awareness of fuel switching/enabling technologies	X	
Build an evidence base to improve BEIS knowledge for industrial decarbonisation	X	

Further Information

Upload further information documents here. Max upload size per file - 10MB Max number of files - 5

- File: CCEL - Lot 2 BatGasDW - Appendix A - Glossary.docx - Download
- File: CCEL - Lot 2 BatGasDW - Appendix D - DUKES 2020 Bioenergy as a percentage of renewables.pptx - Download
- File: CCEL - Lot 2 BatGasDW - Appendix I - Other decarbonisation techniques .docx - Download
- File: CCEL - Lot 2 BatGasDW - Appendix M - UoL early work on gasification of pine wood.docx - Download
- File: CCEL - Lot 2 BatGasDW - Appendix N - Cone Calorimeter small scale gasification.docx - Download

Declaration Forms

Please download the following Green Distilleries Declarations Document to be signed offline and re-uploaded through the link below. If convenient you can use e-signature to sign the documents. Green Distilleries Phase 2 Declarations Max upload size per file - 5MB Max number of files - 1

- File: CCEL - Lot 2 BatGasDW - Green Distilleries Phase 2 Declarations.pdf - Download

Terms and Conditions

Please read the competition's Terms and Conditions (linked below) and select the YES button below to declare you have read them: Green Distilleries Phase 2 Terms and Conditions

	Yes
I have read the Terms and Conditions	X

Application Form Checklist

As well as the completion of this Application Form please check that, if required, you have provided the following information.

	Yes	No
Green Distilleries Project Cost Breakdown Form	X	
Partner Information Form *If more than three Partners*		
Project Plan	X	
Risk Register	X	
Attached supporting documentation *Clearly referenced*	X	

Signatory Page

Enter details below

Name of Organisation	Colorado Construction & Engineering Ltd
Signature ***Please insert name***	[This information has been redacted]
Position in Organisation	[This information has been redacted]
Date (DD/MM/YYYY)	04/05/2021