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Engineering & Project Management for Bio-Carbon Removal

TIER 1 RED FLAG RISK ASSESSMENT

Biomass Pyrolysis / Biochar Asset — Investor Due Diligence Framework

Prepared for:

[Client / Investor Name]

Project:

Hypothetical Pyrolysis Plant — Rice Husk Feedstock (Preliminary Design)

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Purpose & Scope of This Assessment

This Tier 1 Red Flag Risk Assessment is a rapid, investor focused screen of a biomass pyrolysis / biochar project's key commercial, technical, and operational risks. It is designed to be completed early in an investment process, before term sheet or deep technical diligence, to surface material red flags quickly and cost effectively.

Each question below is answered with a risk rating (Low / Medium / High / Not Rated) and supporting findings. The intent is to identify what is missing, unverified, or contractually weak, not to independently re-engineer or re-model the asset.

How ratings are assigned

To keep the distinction between rating levels consistent and defensible, this assessment applies the following logic:

- **Low:** The document/design addresses the question adequately and no material concern is identified at this stage
- **Medium or High:** The document raises a specific, material question that it does not itself resolve (e.g. an assumption is stated but not substantiated, a control is implied but not shown). High is used where the gap carries meaningful capital, safety, or schedule consequence if left unresolved.
- **Not Rated:** The topic is genuinely outside what the reviewed document(s) could address (e.g. contracts, staffing, insurance) rather than a gap the design itself creates. These are not risk free, they simply require a different evidence source, typically management interview or document review, to close out.

Basis of this sample assessment

This sample was completed using the Sample Process Flow Diagram and Mass & Energy Balance (Rev C0, dated 27.08.26) for a hypothetical 4,000 kg/h rice husk pyrolysis plant [available to download in the technical deliverables section of the Lyntra website]. No supporting contracts, HAZOP, financial model, or site information were reviewed. "Not Rated" findings reflect information genuinely outside the scope of that single document, in a live engagement, these would be closed out via management interview and document review, consistent with the full Tier 1 process.

What Tier 1 covers

- Commercial, contractual, and revenue assumption screening
- Technology and OEM/EPC track record verification
- Feedstock, equipment, and safety governance review
- Personnel, operations, and regulatory status check
- A consolidated red flag summary with overall risk rating

What Tier 1 does not cover

- Independent mass and energy balance verification or process re-modelling
- Detailed reactor and OEM technical/mechanical screening (available as a separate Tier 2/3 engagement)
- Site visits, equipment inspection, or feedstock sampling
- Financial model audit or independent valuation
- Legal review of contracts (findings here should be confirmed by the client's legal counsel)

Where this assessment identifies material uncertainty that warrants deeper investigation, Lyntra recommends a scoped Tier 2 or Tier 3 engagement, including detailed reactor/OEM screening, HAZOP review, or independent financial model stress testing, before final investment commitment.

Executive Summary — Red Flag Overview

A consolidated, at a glance risk rating for each diligence area. Ratings scale: Low / Medium / High / Not Rated (information not available within the scope of this sample review).

Diligence Area	Overall Rating
Revenue, Expenses & Profitability	Medium
Technology & Track Record	Medium
Equipment	Medium
Feedstock	High
Quality Control & Testing	High
Safety	High
Personnel & Operations	Not Rated
Regulatory & Permitting	Medium
Commercial & Project Structure	Not Rated

Overall Project Risk Rating: **Medium-High (Preliminary Design Stage)**

Key recommendation: Proceed to a scoped Tier 2 technical review focused on (1) feedstock ash/silica slagging behaviour and moisture sensitivity, (2) confirmation of a lab testing and QC regime supporting H/Corg and registry eligibility, (3) HAZOP and risk register status, and (4) confirmation of EPC contract structure and OEM reference plants, before further capital commitment.

1. Revenue, Expenses & Profitability

Assesses whether the project's income assumptions, carbon credits, biochar, bio-oil, heat, and power, are realistic, contractually secured, and stress tested.

Diligence Question	Rating	Findings / Comments
Can the project achieve the CORC (or equivalent carbon credit) values calculated in the financial model?	Medium	Biochar yield modelled at 30% of wet feed with zero bio-oil co-product. H/Corg ratio not stated on the flowsheet. We recommend a request of the lab data confirming registry eligibility (e.g. Puro.earth <0.4) before relying on modelled CORC volumes.
Are there risks to carbon credit eligibility (methodology, durability, or additionality rule changes)?	Low	Rice husk biochar has established registry precedent; no unusual additionality concerns identified at this stage.
Is there price risk on the carbon credits themselves, separate from eligibility risk?	Not Rated	Financial model not reviewed as part of this assessment, confirm whether a flat or escalating CORC price is assumed, and whether this is hedged.
Has sensitivity analysis been run using realistic downside assumptions (downtime, yield, price)?	High	Design assumes zero heat losses between components (pipes, valves, etc.) and a fixed 85% pyrolysis thermal efficiency. These are optimistic simplifications appropriate for a preliminary mass and energy balance, but the financial model should be stress tested against a lower efficiency, higher loss case before investment.
Are Power Purchase Agreements (PPAs) in place, and are rates and connection terms locked in?	Medium	Flowsheet shows ~6,878 kW of thermal energy available at the heat exchanger outlet (Stream 8). No offtake for this recovered heat has been sighted. confirm a monetisation path exists or that it is excluded from the revenue case.
Will the project meet its supply guarantees, biochar, carbon credits, bio-oil, heat, and electricity?	Low	Elemental mass balance closes to 100% across all species (moisture, ash, C, H, O, N, S, Cl), indicating an internally consistent preliminary design.
Is there sufficient market depth to sell biochar/credits if the named offtaker withdraws?	Not Rated	Not assessable from process design documentation, confirm via commercial due diligence.
Is there an end market for the biochar (soil amendment, filtration, construction)? If not, how is the biochar being used / disposed of?	Not Rated	Not assessable from process design documentation, confirm via commercial due diligence.
Are the parasitic loads used in the financial model realistic?	Medium	Oxidiser combustion air demand is modelled at 13,338 kg/h against a 4,000 kg/h feed rate. Confirm fan and blower electrical loads at this air volume are captured in the opex model. There are no other parasitic loads documented on the flow sheet. Confirm there are no additional material parasitic loads.
Are headcount and staffing costs in the financial model realistic for a plant of this type?	Not Rated	Outside the scope of a process flow diagram, to be confirmed against the O&M plan and financial model.

2. Technology & Track Record

The reactor and its supplier are usually the single largest point of failure in the project. This section screens whether the technology is proven and whether the OEM can actually be relied on post sale.

Diligence Question	Rating	Findings / Comments
Has this vendor built and operated a plant at this scale before, or is this first of a kind (FOAK)?	Medium	Flowsheet is issued as a preliminary design (Rev C0). Confirm the number of reference plants operating at or near this 4,000 kg/h feed rate.
Have we, or can we, speak to a reference customer currently operating this equipment?	Medium	Not yet arranged, recommended as a condition of proceeding to Tier 2 review.
How many reference plants exist, and can they be independently verified?	Medium	To be confirmed directly with the OEM; not derivable from process design documentation.
Is the project wrapped in a single turnkey EPC contract with performance guarantees (Liquidated Damages)?	High	No EPC contract sighted at this stage, the project is at preliminary design only. Flag as a required document before capital commitment.
Is the EPC/OEM financially capable of standing behind those guarantees?	Not Rated	Cannot be assessed until an EPC counterparty and contract are confirmed.
Does the OEM provide after sales support, and/or does the buyer have sufficient in-house skill to operate independently?	Medium	Not confirmed, request OEM service agreement terms.
Is training provided by the OEM as part of the package?	Medium	Not confirmed at this design stage.
Is the control system and documentation fully accessible to the buyer's own team, and not locked to the OEM?	Medium	Not assessable from a process flow diagram, confirm directly with OEM contract terms.
Does the OEM run a formal Factory Acceptance Test (FAT), and will results be made available?	Medium	Not confirmed, recommend requesting FAT procedure.

3. Equipment

Assesses whether the plant and balance of plant equipment are fit for purpose, correctly specified, and supportable.

Diligence Question	Rating	Findings / Comments
Will the equipment do what it is claimed to do?	Medium	Plug screw feeder is a conventional, appropriate choice for rice husk. The design assumes it increases feed bulk density from 120 to 380 kg/m ³ . We recommend confirming this compaction ratio is demonstrated in operation, not only modelled.
Is any equipment missing that should be included in the scope?	High	No particulate capture equipment (cyclone/baghouse) is shown on the flowsheet, yet the assumptions state zero particulate carry over. Rice husk is a high ash feedstock (15.4% ash content); zero carry over is an unlikely real world outcome and should be revisited with a particulate control system in scope.
Is the modelled uptime/availability realistic?	Not Rated	Not stated on the flowsheet, confirm against the vendor's performance guarantee and the financial model's availability assumption.
Is the equipment matched to the feedstock (e.g. screw vs. bucket vs. belt handling)?	Low	Plug screw feeder is a standard, well matched choice for a low bulk density, fibrous material such as rice husk. Other equipment types are not stated. Recommend asking for the full process flow diagram (PFD) and major equipment list before proceeding to tier 2.
What is the air ingress risk to the reactor?	Low	Air ingress is modelled at 11.6 kg/h against 4,000 kg/h feed, a small fraction. Confirm the seal design achieving this figure is field proven with a similar feedstock rather than a design target only.
Are consumables available locally, or is there ample onsite supply?	Not Rated	Not assessable from process design documentation.
What is the expected spare parts lead time and wear life for high duty components (retort internals, screw flights, seals)?	Not Rated	Not assessable from process design documentation. Wear component life and spare parts lead time typically derive unplanned downtime. Request the OEM's recommended spares list and lead times before capital commitment.
Are OEM performance guarantees realistic and achievable?	Medium	Key figures (85% pyrolysis thermal efficiency, 50 W/m ² -K retort heat transfer coefficient) are stated as design assumptions in this document, not as measured or contractually guaranteed OEM performance figures. Confirm which of these are backed by a guarantee.

4. Feedstock

Assesses whether feedstock supply is secure, diversified, and resilient to disruption.

Diligence Question	Rating	Findings / Comments
Is there ample feedstock available within an economical catchment/haulage radius?	Not Rated	Not assessable from process design documentation, requires a feedstock supply study.
How many suppliers are there, is supply sufficiently diversified?	Not Rated	Not addressed in the reviewed documentation.
What happens if one, or all, feedstock suppliers change their mind?	Not Rated	Not addressed in the reviewed documentation.
Is there risk of feed becoming wet or contaminated?	High	Feed moisture is modelled at a fixed 10% under 35°C / 80% RH ambient conditions. Rice husk is hygroscopic; moisture swings beyond this assumption would materially change biochar yield, reactor thermal balance, and the downstream oxidiser duty. Confirm the design has margin for wet season moisture spikes.
Is there enough onsite storage to buffer against seasonal or supply disruption?	Not Rated	Not addressed in the reviewed documentation.
Is the feedstock exposed to price escalation or competing demand risk (e.g. alternative uses as boiler fuel, cement kiln input, animal bedding, or particleboard feedstock)?	Not Rated	Not addressed in the reviewed documentation. Rice husk has multiple existing industrial uses that compete for the same supply pool. This is a distinct risk from supplier concentration (addressed above) and from feedstock switching (addressed below). Requires a feedstock market study.
Could the plant run on alternative feedstocks without major disruption?	Medium	Rice husk has an unusually high ash/silica content (15.4% ash; 617 kg/h SiO ₂ reporting to the biochar stream). The reactor and refractory design are likely tuned to this composition, switching feedstocks would probably require re-validation for slagging risk rather than being a drop in substitution.
Are supplier guarantees on quality and sizing actually written into the contract?	Not Rated	Not assessable from process design documentation, requires supply contract review.

5. Quality Control & Testing

Assesses whether feedstock and biochar quality are actively verified, not just assumed, on the way in and on the way out. This underpins both product liability exposure and ongoing carbon registry eligibility.

Diligence Question	Rating	Findings / Comments
Is there a documented procedure for checking incoming feedstock (moisture, particle size, contamination) on arrival, before it enters the kiln?	Not Rated	Not addressed in the reviewed documentation. Given feed moisture is a fixed design assumption (10%) rather than a measured input, confirm an incoming moisture check exists to catch deviation before it reaches the reactor.
Is out of spec feedstock actually quarantined or rejected in practice, not just on paper?	Not Rated	Not addressed in the reviewed documentation.
Is there a representative sampling procedure for biochar output, rather than ad hoc grab samples?	Not Rated	Not addressed in the reviewed documentation.
Are retained/reference biochar samples kept in case of later dispute or registry audit?	Not Rated	Not addressed in the reviewed documentation.
Is biochar tested at an accredited lab on a regular schedule for contaminants (heavy metals, PAHs, PFAS) and registry required parameters (e.g. H/Corg ratio)?	High	This connects directly to the Revenue section finding above: H/Corg ratio is not stated on the flowsheet and CORC eligibility cannot be confirmed without it. No ongoing lab testing regime has been sighted, this is a precondition for registry eligibility, not a one off check.
Are onsite spot checks (e.g. pH, bulk density, moisture) run regularly to confirm ongoing production matches the lab certified baseline?	Not Rated	Not addressed in the reviewed documentation.
Is there a documented containment and handling procedure between kiln discharge and dispatch to prevent contamination or moisture pickup?	Medium	Biochar discharges at 700°C (Stream 4); no cooling, containment, or handling step is shown downstream of this point on the flowsheet. Relevant both to QC integrity and to the auto ignition risk flagged under Safety, below.
Is QC ownership clearly assigned (in-house QA role or outsourced), with a formal QC plan or SOP?	Not Rated	Not addressed in the reviewed documentation.
Is there a documented non-conformance / hold process for a batch that fails testing, before it can be sold or credited?	Not Rated	Not addressed in the reviewed documentation.

6. Safety

Assesses whether process safety risks have been formally identified and mitigated.

Diligence Question	Rating	Findings / Comments
Have process risks been identified and mitigated, with a formal risk register in place?	High	No risk register sighted. The project is at preliminary design stage (Rev C0), flag as a required deliverable before further capital commitment.
Is there a documented Emergency Shutdown (ESD) procedure?	High	Not yet available at this design stage.
Has a formal safety assessment / HAZOP study been completed?	High	Not sighted. A HAZOP is not expected at the preliminary design stage but should be a condition of proceeding to detailed design / FID.
Is the thermal oxidiser fitted with a burner management system (BMS) / flame safeguard, and is this specified in the design basis?	Not Rated	Not shown on the flowsheet of assumptions list. Flagged as a required piece of equipment that needs to be confirmed.
Are the reactor and thermal oxidiser fitted with pressure relieved devices (PSVs) sized for credible overpressure cases?	Not Rated	Not assessable from a process flow diagram. Confirm sizing calculations exist and are based on the site's credible overpressure scenarios.
Are dust explosion risks mitigated?	Medium	Feedstock and biochar products both carry dust potential given the high ash content; no dust management or explosion venting system is shown on the flowsheet.
Are hot biochar handling and auto ignition risks mitigated?	Medium	Biochar discharge is modelled at 700°C (Stream 4). No cooling or quenching step is shown downstream of the reactor discharge point on this flowsheet, confirm this exists in the full mechanical design.
What happens if a key piece of equipment malfunctions, what risk is exposed?	Not Rated	Not assessable from a process flow diagram, requires HAZOP / risk register review.

7. Personnel & Operations

Assesses whether the people and procedures are in place to actually run the plant reliably.

Diligence Question	Rating	Findings / Comments
Is the team experienced in running this type of operation?	Not Rated	Outside the scope of process design documentation, to be confirmed via management interview.
Is there key personnel risk?	Not Rated	To be confirmed via management interview.
Are Standard Operating Procedures (SOPs) in place for all key procedures?	Not Rated	Not expected at preliminary design stage; flag for follow up prior to commissioning.
Is there adequate training for new hires?	Not Rated	Not assessable at this stage.
Is maintenance handled in-house or outsourced, and is it adequately resourced?	Not Rated	Not addressed in reviewed documentation.
Has syngas handling been accounted for in operational planning?	Medium	Flue gas stream (Stream 8) carries CO ₂ , SO ₂ , and HCl at 900°C; confirm downstream handling and cooling is addressed in the O&M plan.
Is there a documented maintenance schedule?	Not Rated	Not assessable at this design stage.

8. Regulatory & Permitting

Assesses whether the project is compliant with, and has secured, all required approvals.

Diligence Question	Rating	Findings / Comments
Is waste handled in accordance with local regulations?	Medium	Flue gas composition includes SO ₂ (1.6 kg/h) and HCl (3.3 kg/h). No gas cleaning or scrubbing system is shown on the flowsheet, confirm this is addressed in the full design and meets local emission limits.
Are emissions handled in accordance with local regulations?	Medium	The stated assumptions explicitly exclude NO _x from the analysis. This is a reasonable simplification for a preliminary mass and energy balance, but actual NO _x emissions will need to be assessed for air permitting purposes.
Are all required permits actually secured, grid connection, water, wastewater discharge, not merely applied for?	Not Rated	Not assessable from process design documentation.

9. Commercial & Project Structure

Assesses whether the project's commercial and capital structure can absorb realistic setbacks.

Diligence Question	Rating	Findings / Comments
Is there an unallocated CapEx contingency buffer (industry norm ~15–20%)?	Not Rated	Not assessable from process design documentation, requires cost estimate and financial model review.
Is the site lease term secured for at least as long as the debt repayment tenure?	Not Rated	Not addressed in reviewed documentation.
Can the facility secure standard Property, Casualty, and Business Interruption insurance at commercially viable rates?	Not Rated	Not addressed in reviewed documentation.
Does the capital structure survive a realistic cost overrun without breaching debt covenants?	Not Rated	Not addressed in reviewed documentation.