PITCH DECK · BIOMASS TO GREEN HYDROGEN

INTEGRATED BIOMASS PULPING AND HYDROGEN PRODUCTION SYSTEM WITH THE CLOSED LOOP ALKALINE RECOVERY MECHANISM

Hydrogen from farm biomass with CO_2 capture and lignin recovery in one step. Pulp the biomass first, gasify only the fiber, then pass the syngas back through the same liquor. Modelled cost: ₹133/kg against ₹168/kg for conventional biomass gasification, and a projected ₹111/kg if fiber gasifies faster.

₹133.3/kg

base case, 21% below ₹167.8 conventional

₹111.3/kg

projected, if fiber gasifies faster (unmeasured)

₹10.9 lakh

pilot ask: 6 months, to test the two unproven steps

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Concept stage (TRL 2–3) · Provisional patent filed

1 · PROBLEM STATEMENT

Hydrogen from biomass is too costly to scale

~8,000 t

of green hydrogen per year commissioned in India as of Feb 2026, against a 5 Mt/yr target for 2030.

₹168/kg

modelled cost of hydrogen from conventional biomass gasification, our baseline.

14.8 Mt

surplus crop residue a year in Maharashtra alone, mostly low-value or burned.

The specific problem we address

- Conventional plants gasify the whole plant. Lignin and ash make little or no hydrogen but still take up gasifier capacity.
- CO_2 capture is usually a separate bolt-on step, with its own equipment and cost.
- Together these keep hydrogen from biomass expensive, so abundant farm biomass is not turned into hydrogen at scale.

Market figures from public MNRE, state and industry sources, rounded. Cost and revenue figures are model estimates by the founder, not vendor quotes.

Pulp first, gasify the fiber, reuse the liquor

1 · Pulp

Biomass (grass, crop residue, bagasse) is prepared and cooked with NaOH. Lignin dissolves in the liquor; cellulose and hemicellulose fiber is left behind.

2 · Press, dry, gasify

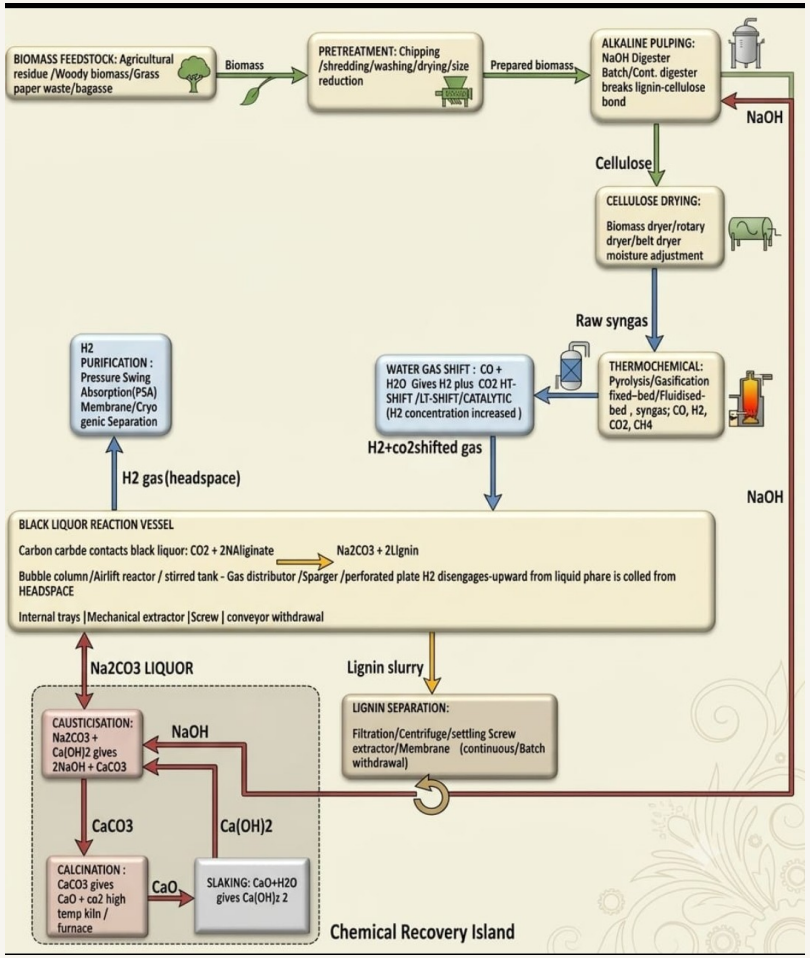
Fiber is pressed (about 80% to 55% moisture) and dried to about 10%, then gasified in a fixed-bed or fluidized-bed gasifier to give syngas.

3 · Shift, then treat in liquor

Water-gas shift raises the hydrogen. The gas then bubbles through the same NaOH liquor: CO_2 forms sodium carbonate and lignin separates for recovery.

4 · Purify and recycle

PSA purifies the hydrogen. Causticizing and calcination turn sodium carbonate back into NaOH and CaO, which return to the process.



Process flow diagram at right. Novelty is the integration of pulping and hydrogen manufacturing, not any single step.

Concept stage: model complete, pilot is the next step

Known building blocks

- Alkaline pulping, gasification, water-gas shift and PSA are each used industrially in some form.
- Causticizing and calcination are standard in pulp mills.
- CO_2 through black liquor to precipitate lignin is known (LignoBoost).

Unproven, to be tested in the pilot

- Fiber gasifies faster than raw biomass, so the same gasifier makes more hydrogen.
- Shifted syngas through the retained liquor gives CO_2 capture and lignin recovery in this integrated loop, with no separate filtration.
- Repeatable results on a fabricated tank.

Readiness today and the path

- Stage: concept, TRL 2–3. Mass and cost model built. No prototype yet.
- IP: provisional patent filed (priority date). Full specification due within 12 months. Attorney prior-art search and India freedom-to-operate check are next.
- Pilot (6 months, ₹10.9 lakh): Phase 1 lab-scale tests of pulping, fiber versus raw-grass gasification, drying, shift and bench liquor tests. Phase 2 builds the liquor tank, runs shifted and unshifted syngas through it, and repeats runs.
- Target after pilot: TRL 4, with measured data to rebuild the cost model.

No claim of a first of its kind: LignoBoost and black-liquor gasification are prior art. Our claim is the integration.

3 · CUSTOMER VALUE PROPOSITION

What each party gains

Hydrogen buyers

- Lower modelled cost per kg: 21% below conventional biomass hydrogen in the base case, up to 34% if fiber gasification is faster.
- Biomass-based hydrogen with CO_2 captured in the process.
- Local supply near industrial clusters.

Farmers

- A new buyer for grass and surplus crop residue.
- About 150–300 farm households per plant (assumption).
- Maharashtra has about 14.8 Mt of surplus residue a year.

Byproduct buyers

- Lignin for binders, resins and carbon materials.
- Ash as a separate stream.
- Lignin price ₹8/kg is an unconfirmed assumption.

Why it is cheaper: a smaller gasifier (only fiber goes in) plus income from lignin and ash that conventional plants waste.

Cost advantage is modelled, not measured. The pilot tests the two key assumptions.

Known routes and where we fit

Approach	What it is	Gap our process targets
Conventional biomass gasification	Whole biomass to gasifier, CO_2 capture bolted on (e.g. IISc–CGPL, IOCL efforts)	Gasifier capacity spent on lignin and ash; separate capture cost; byproducts wasted
Electrolysis (green hydrogen)	Renewable power splits water. Sourced green cost about US$3.5–4/kg	Power-intensive and costly today; needs renewable power supply
Fossil (grey) hydrogen	Steam reforming of natural gas. Sourced cost about US$2.2/kg	Not green; the benchmark buyers use today
LignoBoost (Valmet)	CO_2 through black liquor to precipitate lignin in pulp mills. Patented	A lignin process, not a hydrogen process
Black-liquor gasification	Documented route to hydrogen with causticizing and PSA carbon capture	Gasifies the liquor itself, not pulped fiber
Our process	**Pulp, gasify only the fiber, reuse the same liquor on the syngas**	**Integration, modelled ₹133/kg (₹111 projected)**

Our advantages are cost (modelled), one liquor doing two jobs, byproduct income, modular size, and a filed provisional patent. Provisional filing secures a priority date, not full protection; patents are territorial.

Competitor costs are from public sources, rounded. Our cost compares with the conventional biomass route, not with grey hydrogen.

5 · TARGET CUSTOMER SEGMENTS AND MARKET

Start with distributors and small users, scale from there

Segment	Who	When
Industrial gas distributors	Buy hydrogen and deliver by tube trailer to many small users	First customer
Small and mid-size users	Metal and glass processing, edible-oil hydrogenation, electronics, pharma	First customer
Project developers	MahaGenco REL buyer expressions of interest for its Uran project (not signed offtakes)	Early talks
Refineries and fertilizer plants	About 53% and 44% of India demand. A 1 t/day plant is small for them	At larger scale
Byproduct buyers	Lignin (binders, resins, carbon materials) and ash, buyers unconfirmed	Alongside plant

6.9 → 12 Mt

India hydrogen demand a year, today to 2030

0.52 → 1.5 Mt

Maharashtra demand a year, today to 2030

~1,400 → ~4,100

plants of 365 t/yr that demand could absorb, today and 2030

Priority regions in the MahaGenco REL notice: MMR, JNPT, Trombay, Taloja, Rabale/Turbhe, Patalganga, Dombivli–Kalyan, Thal–Mahad–Roha.

5 · BUSINESS MODEL

Sell hydrogen, lignin and ash from one plant

Revenue streams

- Hydrogen: main product, sold to distributors and industrial users.
- Lignin: assumed ₹8/kg (unconfirmed).
- Ash: assumed ₹2/kg.
- Possible upside: SIGHT incentive of ₹50, 40, 30 per kg over three years (eligibility to be confirmed).

Pricing and distribution

- Price set against the buyer’s current hydrogen cost, with a margin over our cost.
- Supply by tube trailer, or by pipeline if the buyer is next to the plant.
- Grass sourced by contract from nearby farmers.
- Later option: license the process or build plants for others.

Illustrative unit economics at an assumed selling price of ₹160/kg

Per year	Base, 1,000 kg/day	Projected, 1,500 kg/day
Hydrogen revenue	₹5.84 Cr	₹8.76 Cr
Running cost	₹2.37 Cr	₹3.48 Cr
Lignin and ash sales	₹0.98 Cr	₹1.46 Cr
Operating surplus	**₹4.4 Cr**	**₹6.7 Cr**
Simple payback on plant cost	about 6.6 years	about 5.1 years

₹160/kg is illustrative, not a market quote. Before tax, at full output. About 7.4 years at 90% uptime, 8.2 years with no lignin income (base).

5 · GO-TO-MARKET AND GROWTH PLAN

From pilot to repeatable plants

Phase 0 · now to 6 months

Run the ₹10.9 lakh pilot at an incubation centre. DPIIT recognition, patent attorney search, India freedom-to-operate check. Seek buyer letters of intent.

Phase 1 · after the pilot

Rebuild the cost model on measured data. Apply for NIDHI-PRAYAS and SISFS through an incubator, and the MNRE-BIRAC pilot call. Sign supply terms for grass and a first buyer.

Phase 2 · first plant

One plant of 1,000–1,500 kg/day, ₹29–35 Cr, near an industrial cluster with distributor offtake.

Phase 3 · replicate

Repeat plants in clusters near surplus biomass. Plant cost falls with size: ₹167.8/kg at 500 kg/day, ₹133.3 at 1,000, ₹108.2 at 2,000. Option to license the process.

Channels: gas distributors, direct industrial users, farmer contracts, incubators and government programmes.

Phases after the pilot depend on funding and pilot results; they are plans, not commitments. Scale costs are model estimates.

COST ESTIMATION 1 · THREE CASES SIDE BY SIDE

How ₹167.8 becomes ₹133.3 and ₹111.3 per kg

Item	Conventional	Ours, base	Ours, projected
Hydrogen per day	1,000 kg	1,000 kg	1,500 kg
Plant cost (CAPEX)	₹29.0 Cr	₹29.3 Cr	₹34.7 Cr
Plant cost per kg/day of output	₹29.0 lakh	₹29.3 lakh	₹23.1 lakh
Running cost (OPEX) per day	₹71,178	₹65,018	₹95,430
Running cost per kg	₹71.2	₹65.0	₹63.6
Lignin and ash sales per kg	0	- ₹26.7	- ₹26.7
Net running cost per kg	₹71.2	₹38.3	₹36.9
Capital charge per kg (12.15% a year)	₹96.6	₹94.9	₹74.3
TOTAL cost per kg	**₹167.8**	**₹133.3**	**₹111.3**
Compared with conventional	baseline	21% lower	34% lower

Of the ₹56.5/kg saving, about ₹27 comes from selling lignin and ash and about ₹22 from using the same gasifier harder (projected case only). The base case does not depend on faster gasification.

Capital charge: 12.15% a year on plant cost excluding working capital, divided by kg made a year. Projected case needs about 61,500 kg wet grass a day.

COST ESTIMATION 2 · PLANT COST BY ITEM

Where the capital goes, in crore and rupees per kg

Plant item	Base ₹ Cr	Base ₹/kg	Projected ₹ Cr	Projected ₹/kg
Gasifier	6.30	20.9	6.30	14.0
PSA hydrogen purifier	3.30	11.0	4.04	9.0
Pulping unit	2.20	7.3	2.69	6.0
Water-gas shift reactor	2.20	7.3	2.69	6.0
Dryer	2.10	7.0	2.57	5.7
Gas cleaning	1.80	6.0	2.20	4.9
Feedstock (grass) handling	1.70	5.7	2.08	4.6
Causticizing, calcination, liquor tank, press	3.00	10.0	3.67	8.1
Land, utilities, engineering	2.80	9.3	3.42	7.6
Contingency and pre-operation	3.14	10.4	3.84	8.5
Total, excluding working capital	**28.5**	**94.9**	**33.5**	**74.3**

Base plant cost including ₹0.8 Cr working capital is ₹29.3 Cr. Individual equipment lines are engineering estimates, not vendor quotes. The projected split keeps the gasifier the same size (₹6.3 Cr) and scales every other item by about 1.22 to match ₹33.5 Cr; this split is my estimate.

Running cost is about ₹4,200 a day fixed plus ₹60.82 per kg of hydrogen. The model does not split running cost by grass, chemicals, power or labour.

COST ESTIMATION 3 · SCALE, PILOT AND FUNDING

What it costs to prove it, and to build it

Cost per kg by plant size

500 kg/day	**₹167.8**
1,000 kg/day	**₹133.3**
2,000 kg/day	**₹108.2**

Funding path after the pilot

DPIIT recognition, then NIDHI-PRAYAS (up to ₹20–40 lakh) and SISFS (up to ₹20 lakh grant plus ₹50 lakh debt or convertible) through an incubator, and the MNRE-BIRAC call. First plant ₹29–35 Cr.

Pilot budget, ₹10.9 lakh over 6 months

Use of funds	₹ lakh
Liquor tank, built and owned	2.3
Rented gasifier, shift reactor, PSA time	2.0
Raw material	1.0
Testing and gas analysis	1.3
Facility, consumables, documents	2.2
Travel	1.6
Contingency	0.5
Total	**10.9**

Within the ₹15 lakh prototype cap. Scale costs are from the model using a six-tenths scale rule.

Programme limits are as understood by the founder and should be confirmed with each scheme before applying.

Founder-led, with support being put in place

Mhaske Yash Sandip

Founder and sole inventor

- Third-year mechanical engineering, AISSMS College of Engineering, Pune (SPPU). CGPA about 7 across Semesters 1–4.
- Completed an energy literacy course (Swarajya).
- Selected for MSME Hackathon 6.0 with this project, now at the third level. COEP Bhau is the host institute for the hackathon.
- Top-10 shortlist, YUKTI Innovation Challenge 2026, AISSMS (team leader).
- Holds the provisional patent filing as individual inventor, with 100% ownership of the IP.
- Ahilyanagar district, Maharashtra.

Organization structure

- Today: founder-led. No company is registered yet.
- Incubation: support is needed for prototype development, including equipment access. A technical mentor is also being sought.
- Planned with funding: a process engineer, a lab technician and plant operators.

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Planned roles are plans, not hires made. No team members beyond the founder are listed.

ASSUMPTIONS AND RISKS

What could change these numbers

Item	Why it matters	How it is handled
Fiber gasifies faster	Drives the ₹111 case (about 1.5 times the throughput)	Tested first in the pilot, fiber against raw grass in the same gasifier
Syngas through the liquor	Core of the integration: CO_2 capture and lignin recovery in one step	Bench test, then fabricated tank with shifted and unshifted syngas
Lignin price	₹8/kg is unconfirmed; at zero the base cost is about ₹156.5/kg	Seek buyer quotes and samples during the pilot
Equipment prices	Gasifier, PSA and shift are estimates, not vendor quotes	Obtain quotes after pilot data
Grass supply	Projected case needs about 61,500 kg wet grass a day	Farmer contracts; test supply radius
Buyers and distance	Buyers are targets, none signed; grass and buyers are far apart	Letters of intent; find a nearer buyer cluster
IP	Provisional only; LignoBoost and black-liquor gasification are prior art	Attorney search and India freedom-to-operate check

Plasma-assisted water-gas shift is a future idea that has not been checked for prior art and is not part of the costed process.