



IEA Bioenergy
Technology Collaboration Programme

Country Update – India

Gasification of Biomass and Waste

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IEA Bioenergy : Task 33 meeting

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Technology Collaboration Programme

by **iea**

Outline

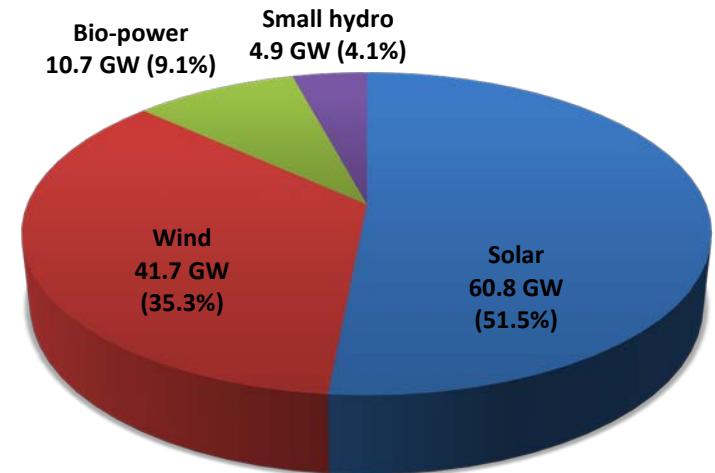
- Share of bioenergy in India's energy basket
- Biomass availability in India
- Bioenergy deployment in India
- Recent bioenergy updates
- National green hydrogen mission
- Biomass gasification based hydrogen generation



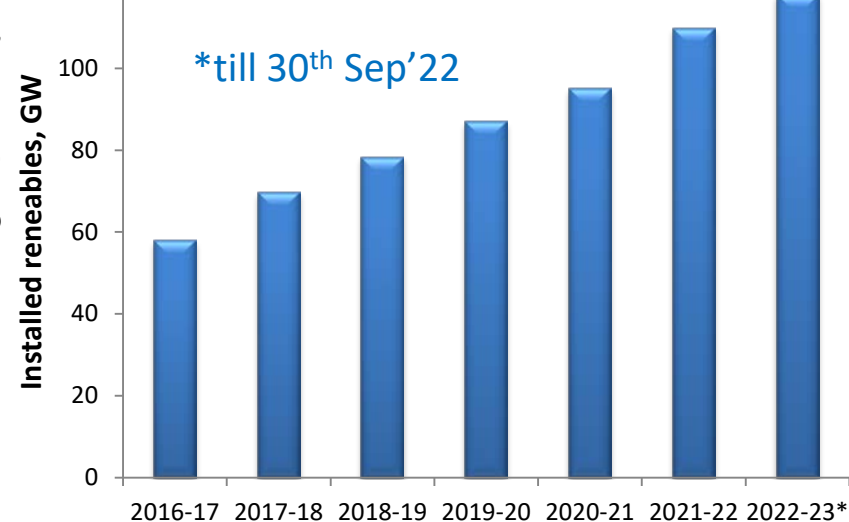
Share of bioenergy in India's energy basket

- Total primary energy demand in 2021 : ~927 MTOE
- Coal is the top energy source with a share of 44%, followed by oil (24%)
 - Share of biomass energy : ~22%
 - Share of natural gas : ~6%
- Installed power capacity as on Sep'22 : ~408 GW
 - Share of RES: ~ 29% (118 GW)
 - Biomass & waste to power capacity : ~10.7 GW
- Installed RES increased at a fast pace over the past few years, posting a CAGR of 15.4% between 2016-22
- Ambitious target of 500 GW RES capacity by 2030

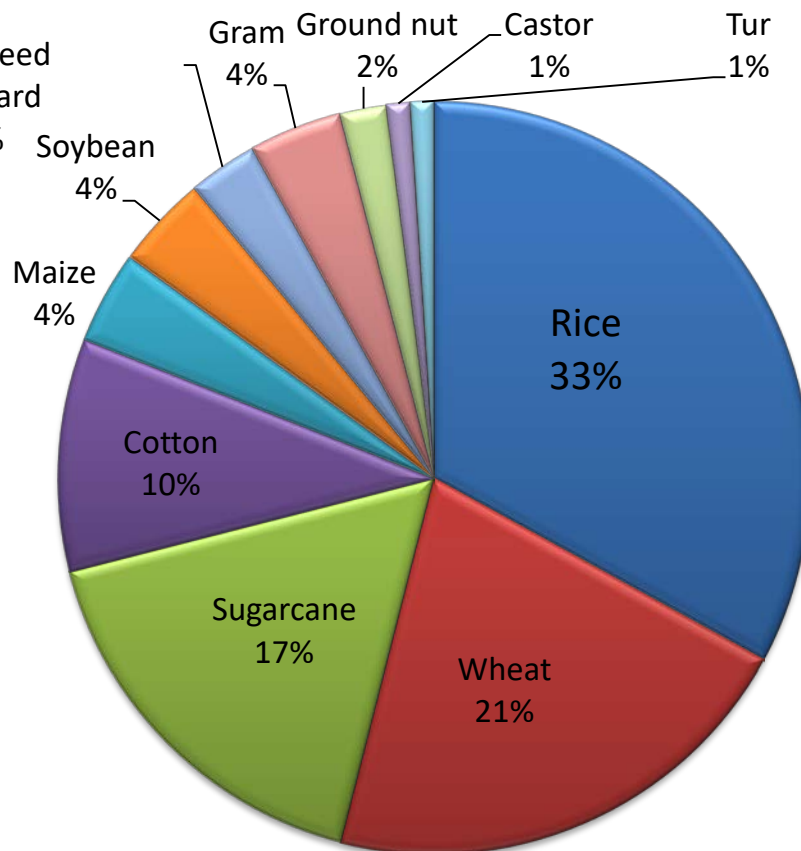
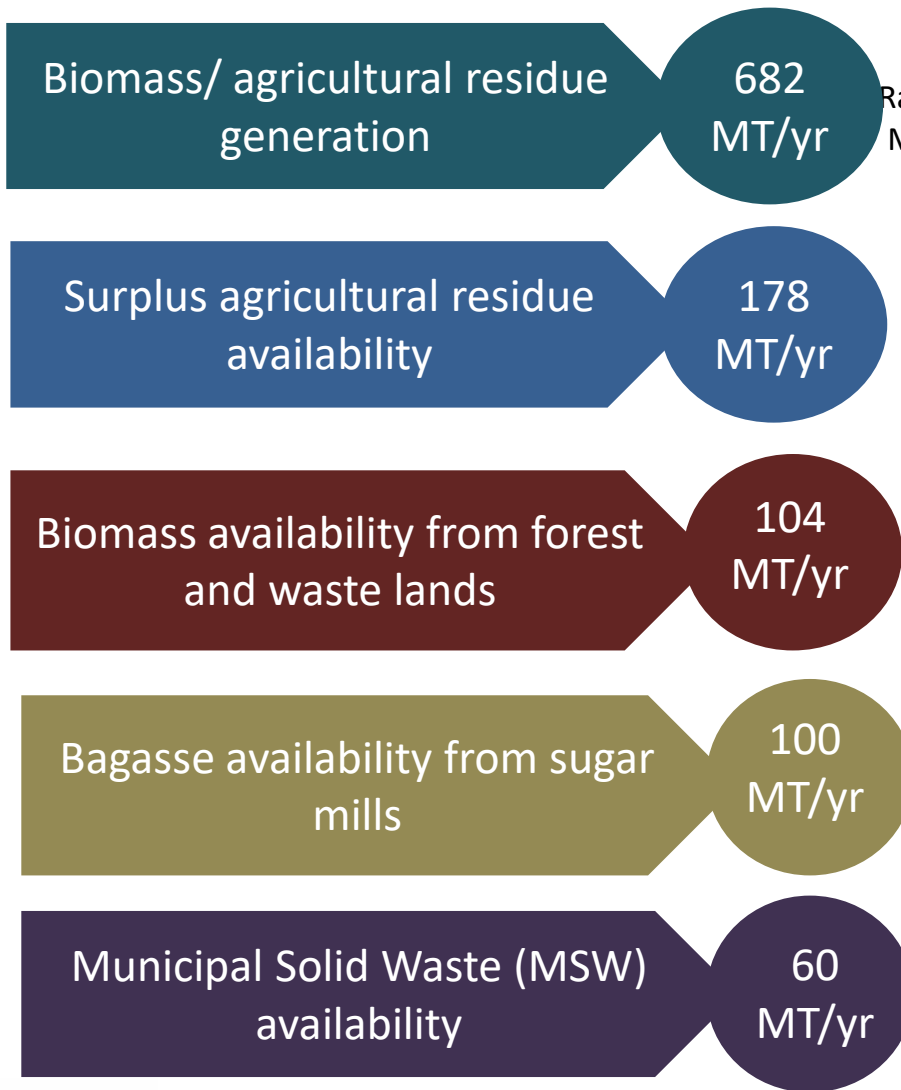
Break up of renewables as on 30th Sep'22



Growth in installed RES over FY 16 - 23*



Biomass availability in India



Rice, wheat, sugarcane and cotton accounts for more than 80% of crop residue regeneration

Source : TIFAC report, 2018; and Centre for Science and Environment report, 2020

Bio-energy deployment in India

Biomass power

- Biomass gasification – electricity generation & thermal energy generation
- Bagasse based cogeneration
- Biomass co-firing in existing coal based power plants

Compressed Bio Gas (CBG)

- Sustainable Alternative Towards Affordable Transportation (SATAT) scheme launched by MoPNG in Oct'18
- PSU Oil Marketing Companies invite Expression of interest to procure CBG from potential entrepreneurs
- As on 31st Aug'22, 3497 LOIs issued & 37 plants commissioned

Bio-ethanol

- Second generation (2G) ethanol bio-refineries using cellulosic and lignocellulosic materials like rice/ wheat straw, corn cobs, cotton stalk, etc.
- PSUs Oil Companies are in the process of setting up 12 2G ethanol plants in various parts of the country



Biomass co-firing in coal based power plants

- Union Ministry of Power vide revised policy dated 08th Oct'21 mandated co-firing of 5-10% biomass in all thermal power plants
- The Ministry had ordered that all thermal power plants ensure 5% co-firing compliance by Oct'22
- National mission on biomass co-firing - SAMARTH (Sustainable Agrarian Mission on use of Agro Residue in Thermal Power Plants)
- As of 03rd Oct'22, 83,000 tonnes of biomass have been co-fired in 39 thermal power plants across the country
- Generated close to 55,390 MW of power
- India has around 180 thermal power plants; & many power plants are not compiling with the policy on biomass co-firing
- To encourage biomass co-firing, ministry is considering reduction in coal supply for those thermal power plants that do not comply with the policy on biomass co-firing



IndianOil commissions first 2G ethanol plant in Panipat

- Sep up based on Praj's proprietary technology processing Rice Straw as feedstock for the production of Ethanol
- Can process 2 lakh tonnes of rice straw annually to generate around 3 crore litres of Ethanol
- Assist to meet India's target of 20% ethanol blending in petrol by 2025



National Hydrogen Mission

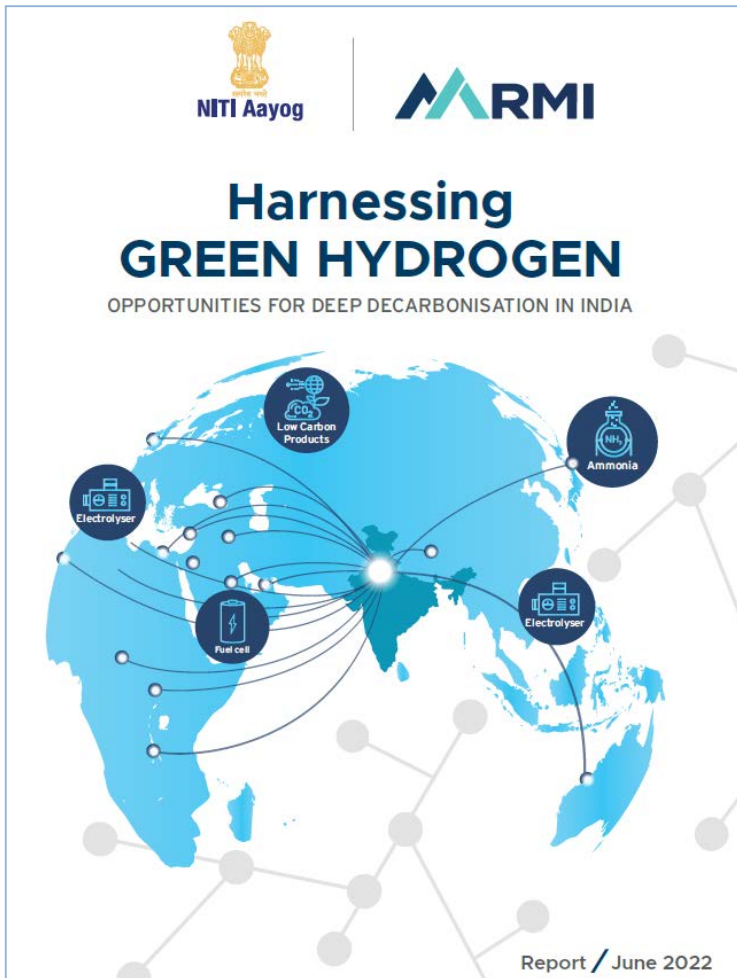
- Honorable prime minister launched NHM on India's 75th Independence Day
- Aims to aid the government in meeting its climate targets and making India a green hydrogen hub
- Green hydrogen policy framed by GOI for implementation by all the concerned stakeholders
- Ministry of Power notified Green Hydrogen/ Green Ammonia Policy on 17th Feb, 2022
- Hydrogen/ ammonia produced from biomass named as GREEN
- Waiver of inter-state transmission charges for 25 years to producers of green hydrogen from the plants commissioned before 30th June, 2025
- Open access to be granted for sourcing renewable energy within 15 days of receipt of application



Source : Green hydrogen policy, No. 23/02/2022-R&R, GOI, Ministry of power , 17th February, 2022



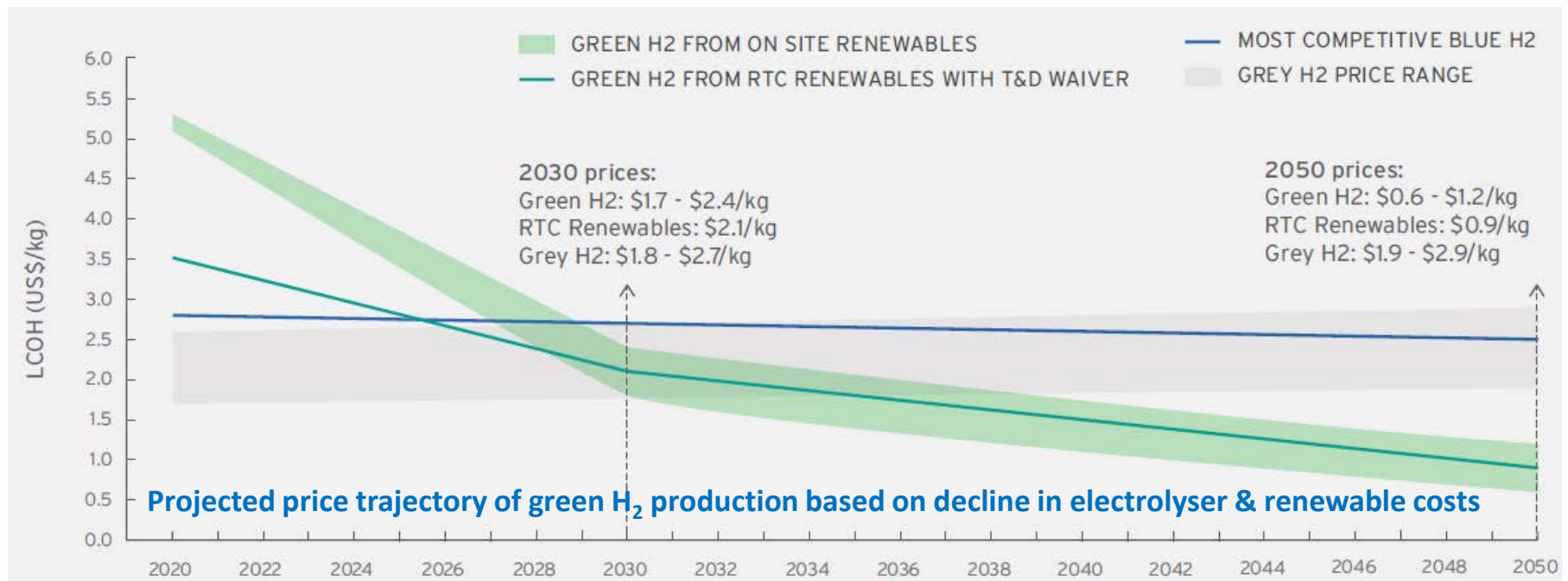
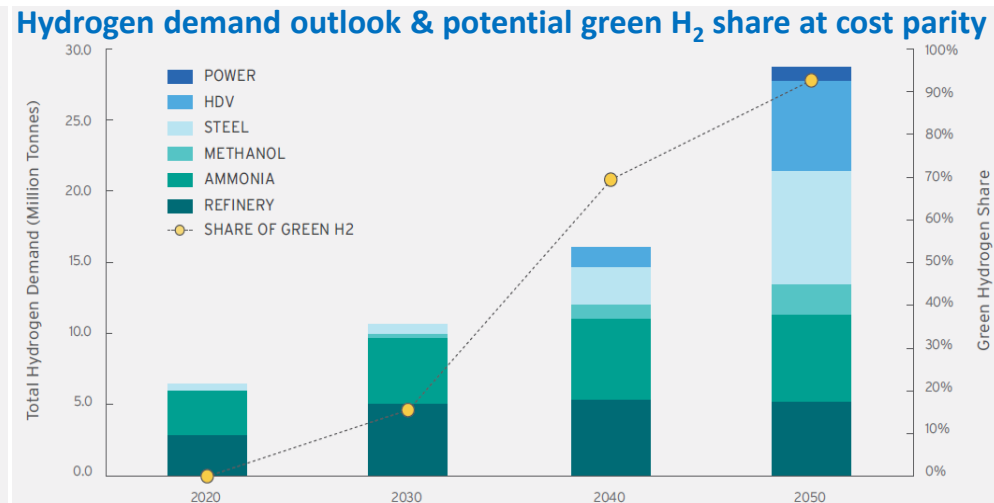
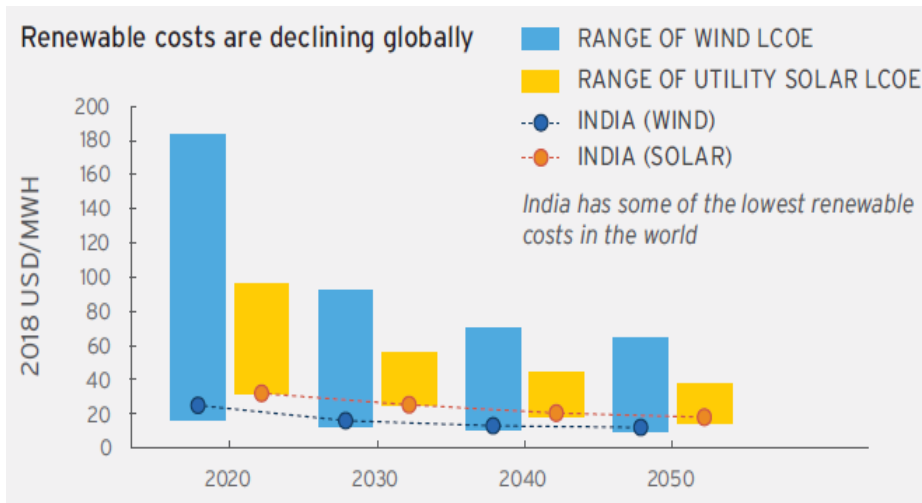
Harnessing green hydrogen report by NITI Aayog



- If right steps are taken, India can achieve :
 - ✓ The world's largest electrolysis capacity of over 60 GW/ 5 million tonnes by 2030 for domestic consumption
 - ✓ The world's largest production of green steel at 15-20 million tonnes by 2030
 - ✓ The world's largest electrolyser annual manufacturing capacity of 25 GW by 2028 delivering affordable ones for India and the world
 - ✓ The world's largest production of green ammonia for exports by 2030
 - ✓ \$1 billion investment into hydrogen research and development to enable breakthrough technologies

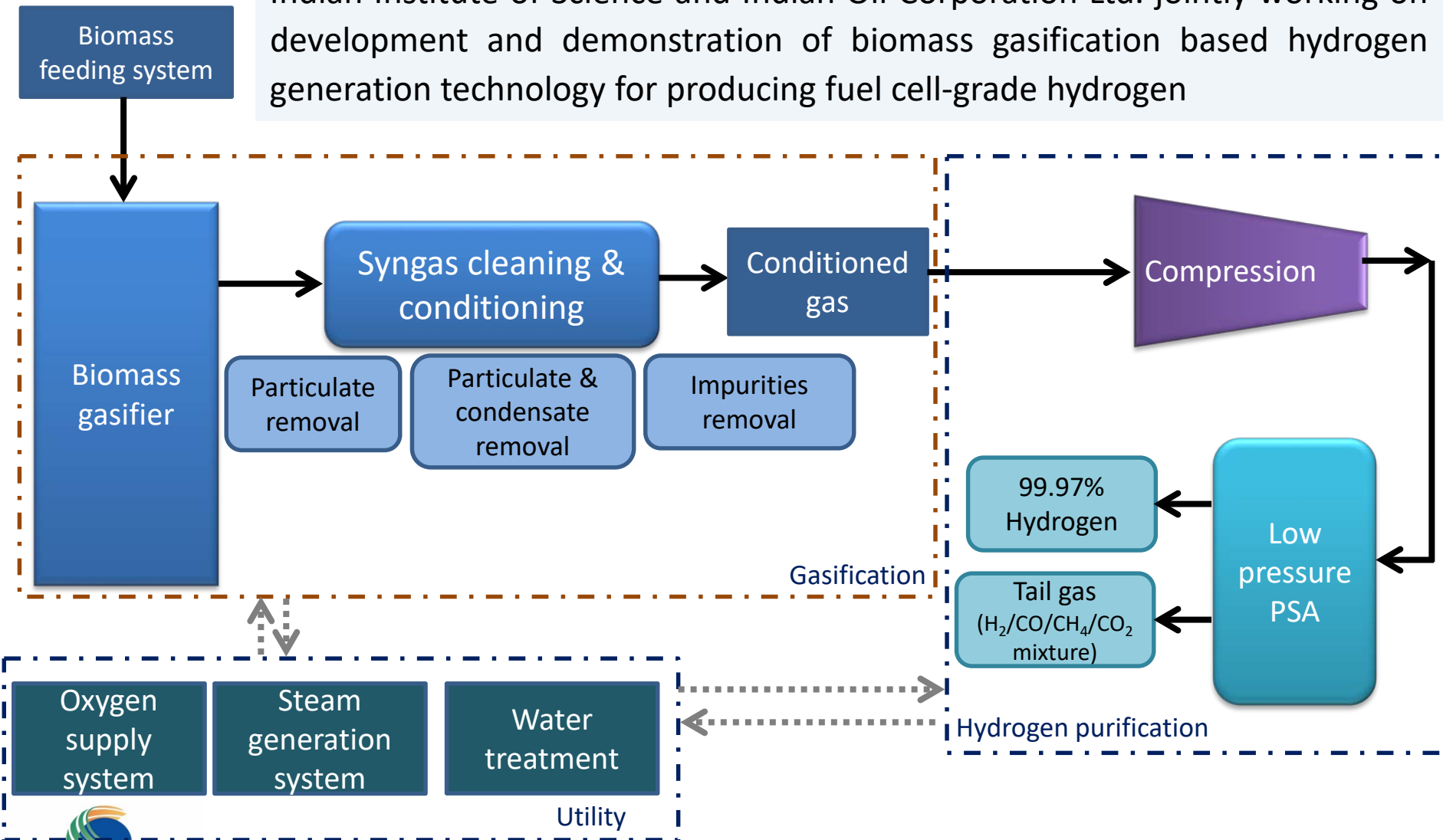


Projected green hydrogen outlook for India

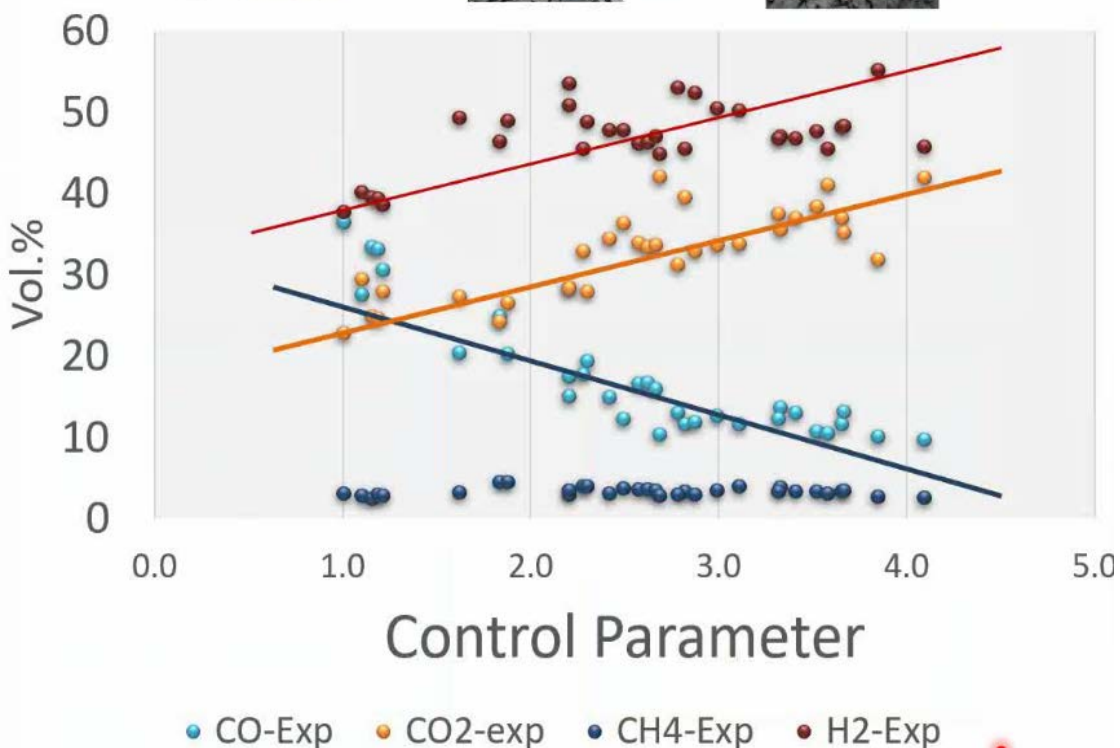


Biomass gasification based hydrogen generation

Indian Institute of Science and Indian Oil Corporation Ltd. jointly working on development and demonstration of biomass gasification based hydrogen generation technology for producing fuel cell-grade hydrogen



Oxy-steam gasification results



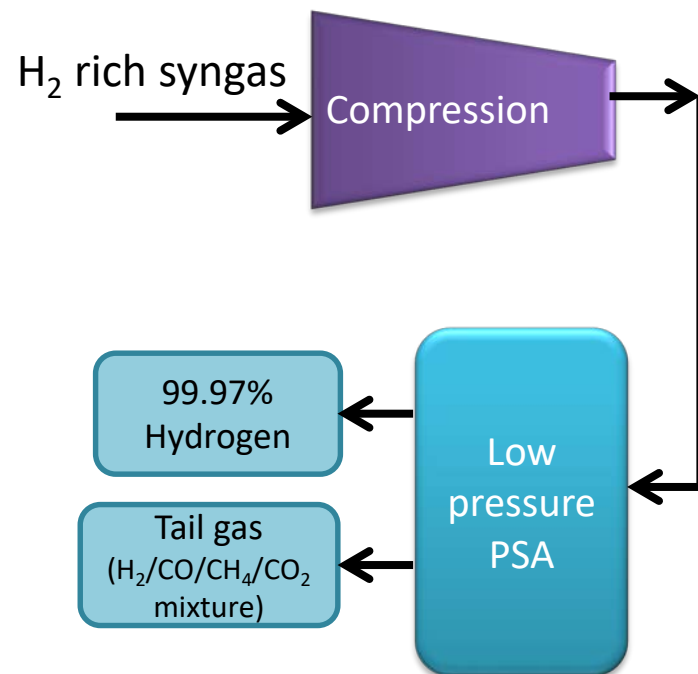
	Casuarina (CP 1.9)	Coconut shells (CP 1.8)
H ₂	48.9± 2	44.1
CO	20.2± 1.5	23.2
CH ₄	4.4± 0.8	3.6
CO ₂	26.5± 2.1	29

	Casuarina a (CP 1.9)	Casuarina (CP - 2.8)	Casuarina (CP - 3.8)
H ₂	48.9	50.7	55.2
CO	20.2	15.3	10.1
CH ₄	4.4	3.3	2.7
CO ₂	26.5	30.7	31.9

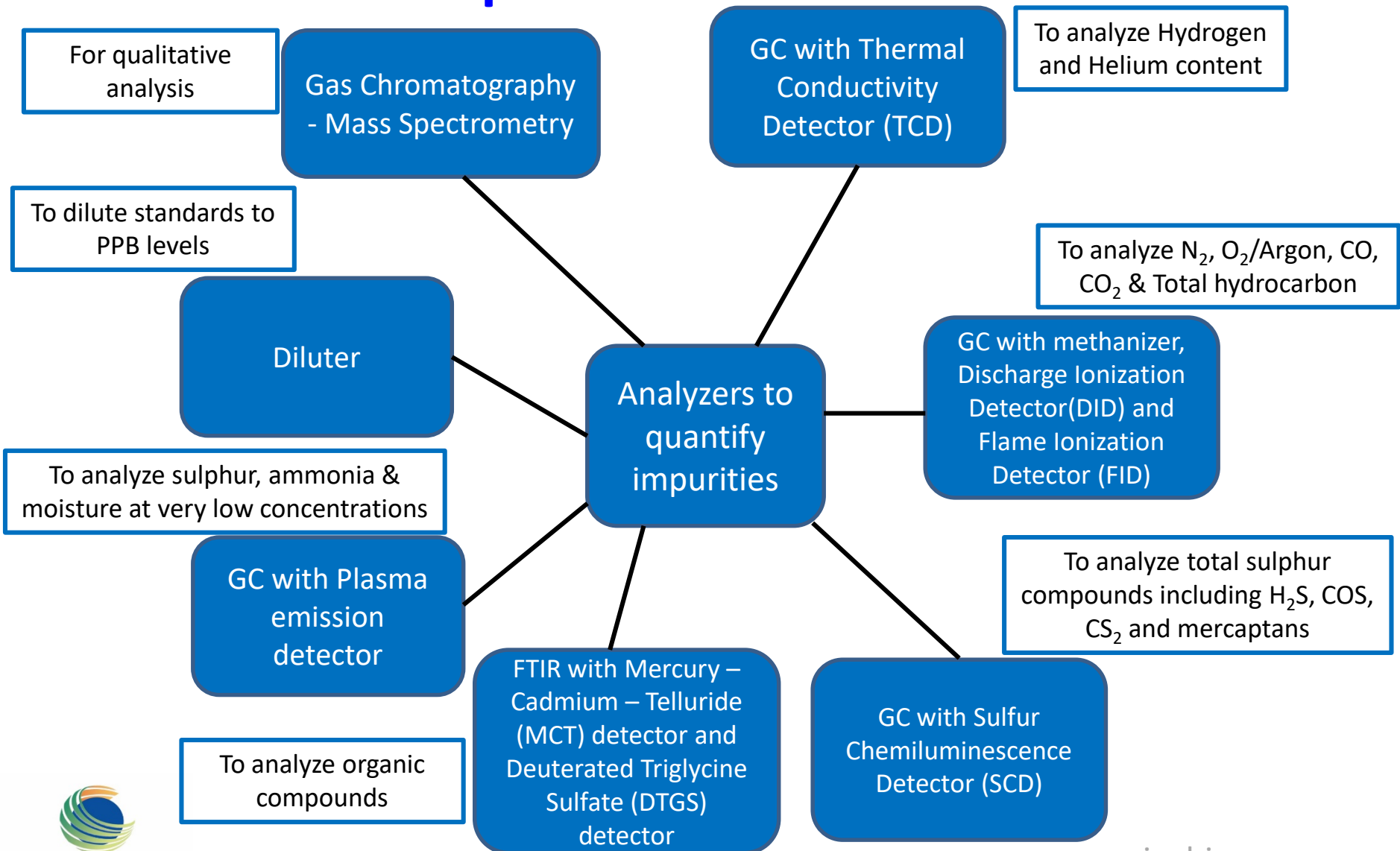


Hydrogen separation from syngas

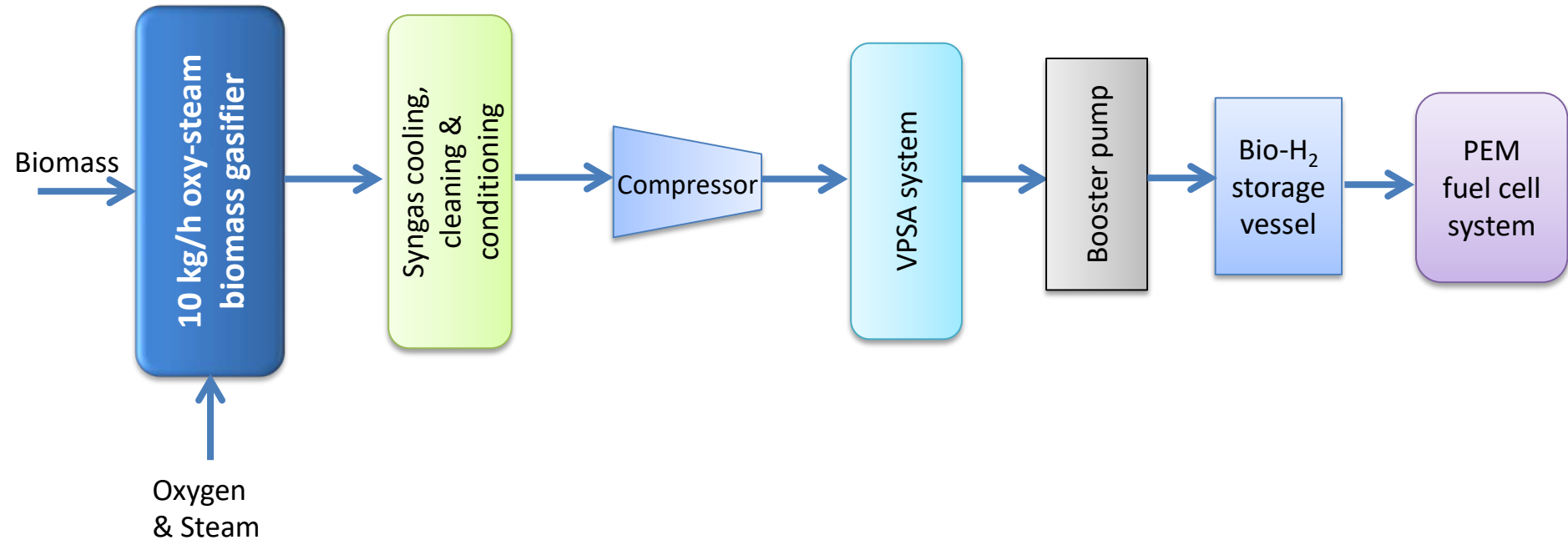
- Adopted Vacuum Pressure Swing Adsorption for separation of fuel cell grade hydrogen from other gases
- Demonstrated hydrogen separation on slip stream in 10 kg/h and 100 kg/h biomass gasification system
- Optimization of process parameters has been completed
- Multi-column PSA operations standardized
- Generated hydrogen meeting PEM fuel cell specification as per ISO 14687: 2019 specification



Analysis of bio-H₂ for quantification of impurities specified under ISO



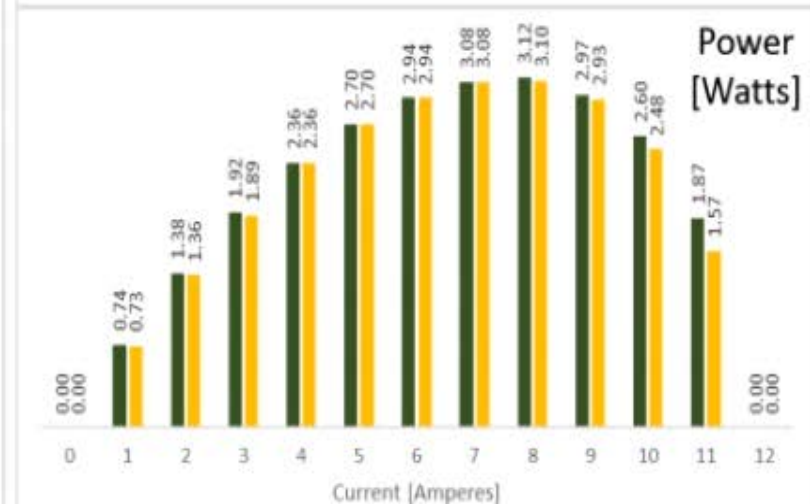
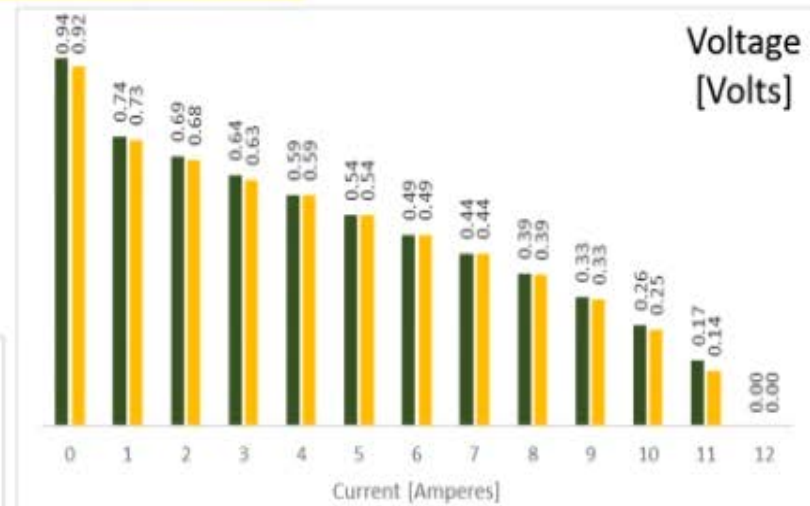
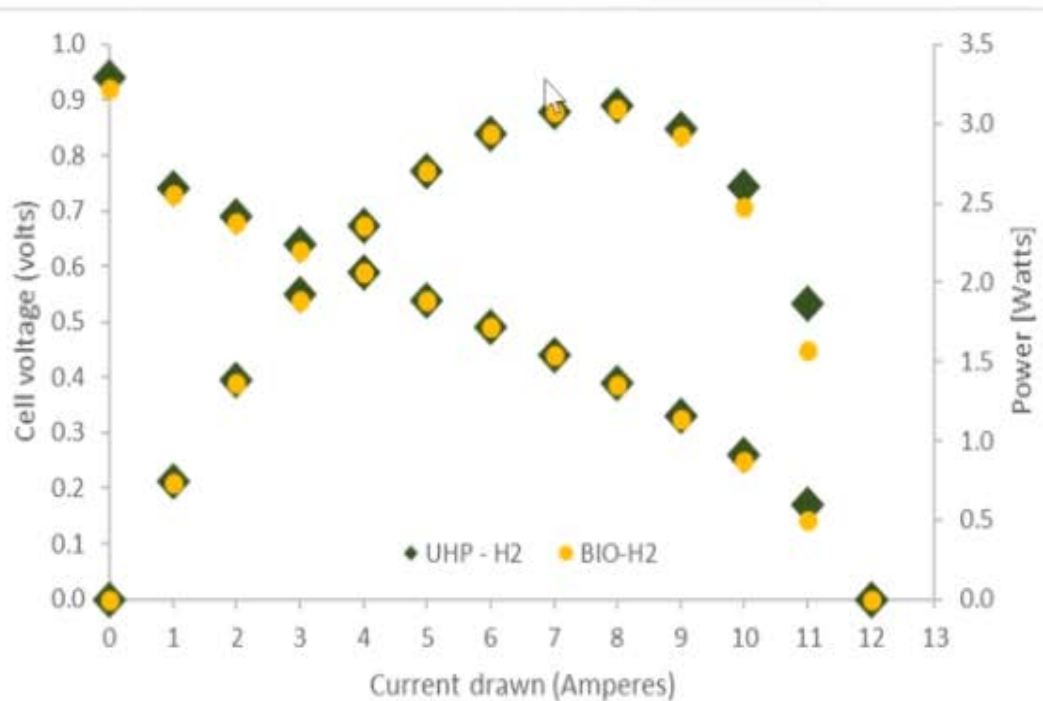
Fuel cell performance evaluation using generated bio-H₂



- Baseline performance established using ultra pure hydrogen
- Performance evaluated using bio-hydrogen generated from biomass

Fuel cell performance evaluation using UPH H₂ & bio-H₂

Parameter	Quantity
Hydrogen flow rate	150 mLPM
Oxygen flow rate	300 mLPM
Test point time	300 seconds each



Thank You

