Advanced biomass-steam gasification technology for “Green hydrogen production"

"Gasification India 2022 -
Waste to Energy".

Gasification: A New Wave of Projects

15 & 16 November 2022, Hyatt Centric, New Delhi

Dr. P Raman

Energy Efficiency and Environment Private Limited.

New Delhi-110077

https://cleanenergyee.com/

15 & 16 November 2022, Hyatt Centric, New Delhi

Outline of the presentation

- Present scenario of hydrogen production
- A comparison of cost of the hydrogen production from different sources.
- Green hydrogen production through biomass-steam gasification
- A process of “Green Hydrogen” from biomass waste
- Challenges related to biomass gasification for GH2 production
- Advanced Three Stage (ATS) gasifier for green hydrogen production
- Salient features of the ATS gasifier system
- Multiple types of biomass wastes as a source for GH2 Production
- Containerized gasifier system for GH2 production
- Scenario of hydrogen consumption and Targets
- Green hydrogen from biomass waste- A complete energy solution
- Conclusions

Present scenario of hydrogen production

- Presently green hydrogen is produced through electrolysis process, by using the electricity generated from Photovoltaic plant or wind mills.
- In electrolysis process, about 48 units of electricity (173 MJ) is consumed to produce one kg of Hydrogen.
- Biomass steam gasification is an efficient technology for green hydrogen production
- In biomass-steam gasification process 8 kg of biomass (144MJ) is consumed to produce one kg of Hydrogen.
- Green hydrogen production through biomass-steam gasification process is almost 6 times cost efficient than electrolysis process.

A comparison of cost of the hydrogen production from different sources.

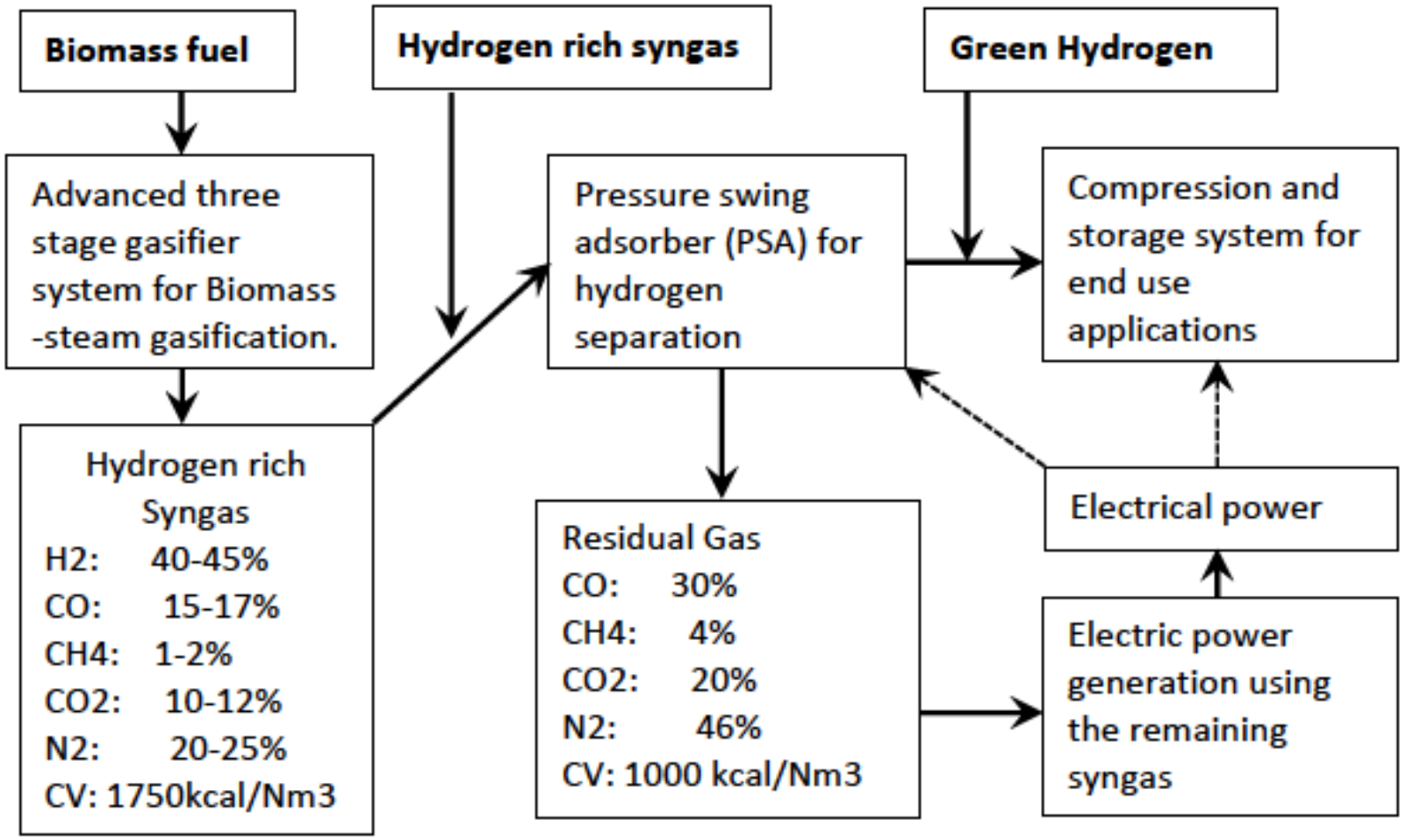
S. No.	Source	$/kg of GH2 production
1	Green hydrogen from PV power, through electrolysis	3.4
2	Green hydrogen from wind power, through electrolysis	2.7
3	Methane pyrolysis (Reforming of Natural gas)	2.0
4	Hydrogen production through coal- steam gasification	4.79
5	Green hydrogen production through Biomass-Steam Gasification	0.9

Electrolysis process: 48 kWh electricity per kg of green hydrogen
Biomass-steam gasification: 8 kg of biomass per kg of green hydrogen

Green hydrogen production through biomass-steam gasification

- Green hydrogen from biomass can be used to reduce the use of fossil fuels and to reduce GHG emissions
- Biomass is considered to be the prominent form of energy source
- Biomass is a renewable energy source and it is carbon neutral
- Global energy contribution by Biomass is 10-14%
- In the remote and rural areas 90% of the total energy demand is met by Biomass
- Biomass is a low-cost fuel in compared to fossil fuel ($/MJ)
- 13 % (940 million) of the world population do not have access to electricity
- Green hydrogen from biomass can provide complete energy solution for power generation, industrial need and transportation

A process flow diagram of "Green Hydrogen" production through biomass-steam gasification using Advanced Three Stage (ATS) gasification technology (Developed by Energy Efficiency and Environment P Ltd.)



Challenges in biomass gasification for green hydrogen production

- The main problems associated with biomass gasification system are:
  - Quality of the gas; presence of impurities like **Tar** and dust.
  - Presence of tar in the syngas affects the performance and life of hydrogen separation equipment (PSA columns and compressors)
  - Removal tar was a great challenge
  - Challenges related to gasification of multiple types of biomass wastes (agricultural and municipal solid wastes)

There is a need for a gasifier system which can use different type of biomass and to produce **“Hydrogen rich syngas with out TAR”**

Advanced three stage gasification system, which can use multiple types of biomass wastes

**(A patented Technology:
Patent No. 402047;
Application No.: 202011007165 / 2020)**

Salient features of the ATS biomass-steam gasifier system suitable for green hydrogen production

Multiple inputs

- Generates high quality Syngas– alternate to conventional fuels like diesel, furnace oil, coal, etc.
- ATS is capable of using multiple types of biomass : fuel wood (from plantations), agricultural residues and Densified MSW
- Most systems globally are fuel specific

Zero tar

- The conventional gasifier systems require expensive and energy intensive equipment for tar removal.
- The ATS employs a tar cracker unit which produces tar-free high-quality Syngas (heating value of 1200 ~ 1300 kcal/Nm3).

Low maintenance

- ATS requires significantly low maintenance
- It employs a compact dry-cleaning system
- It does not use cleaning systems such as bag-house filters, wet-scrubbers, etc.
- Can be operated continuously with minimal troubleshooting/ down-time

Sustainable and durable

- Built using high-quality heat-resistant stainless-steel.
- Highly durable and economical as compared to other gasifier systems.

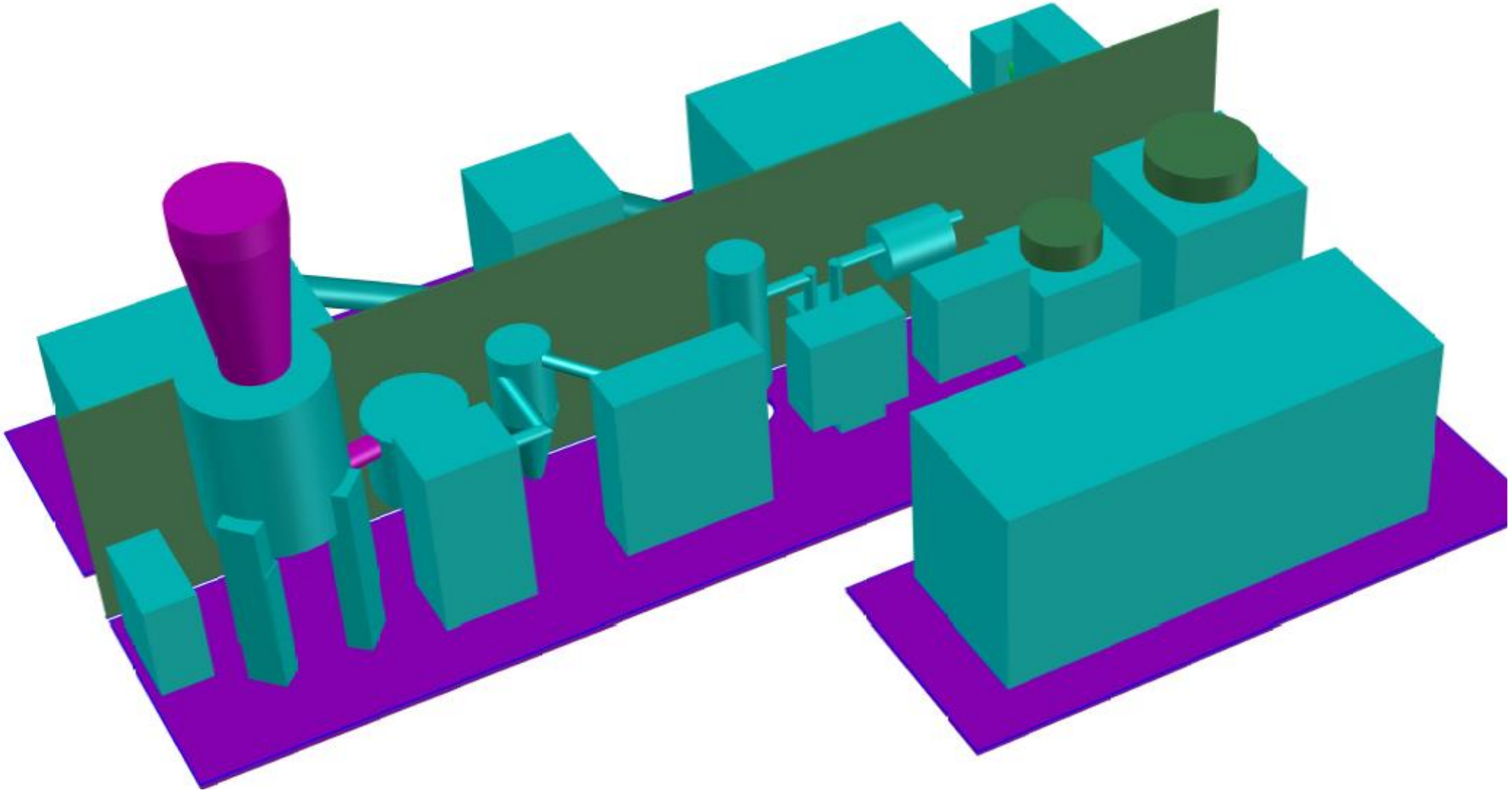
Easy and quick installation

- Containerized systems facilitates quick installation and set-up.
- The System can be installed in 2 days compared to Conventional systems, which take 15 ~ 20 days.

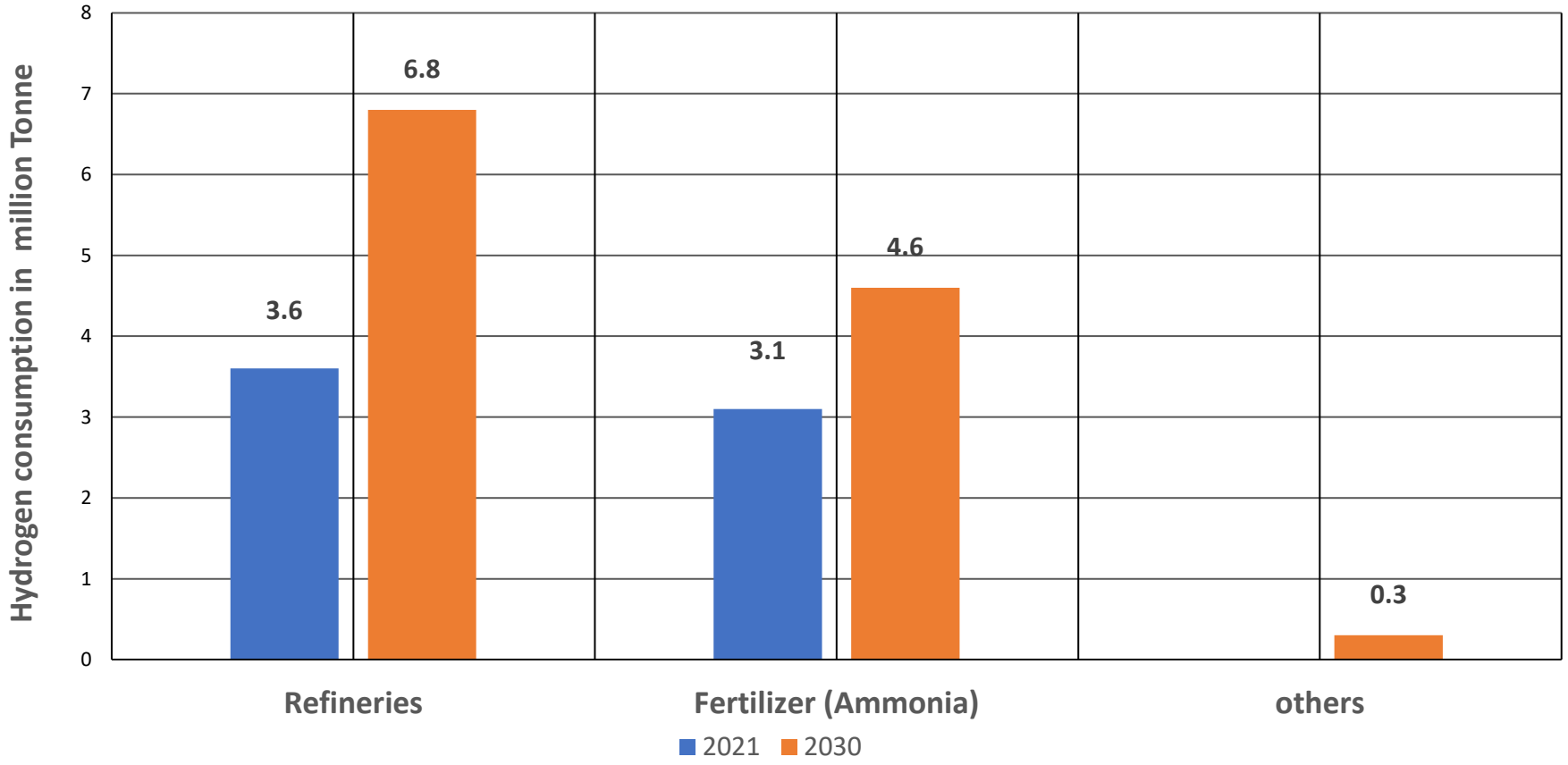
Biomass Waste for green hydrogen production

Developed one of world's most advanced technology for **biomass gasification. An Advanced three-stage ("ATS") gasifier system**. It has multiple applications and is **economical, efficient and environment friendly**.

A view of the containerized ATS gasifier system



Scenario of hydrogen consumption in India, now and in 2030



Source: https://www.livemint.com/industry/energy/govt-charts-course-for-usage-of-new-age-fuel-11625078901655.html

Govt plans to implement green hydrogen consumptions and options for achieving the goal

- Implement “Green Hydrogen Consumption Obligation (GHCO)” in fertilizer production and petroleum refining
- To use 10 % of green hydrogen (GHCO) in Fertilizer industries by 2030, which is 4.6 lakh tonne of GH.
- Present cost of green hydrogen is Rs. 350/kg and the Govt plan is to have at Rs. 160/kg by 2030.
- Presently at the global level only 4 % of hydrogen is from renewable energy sources and rest is from natural gas and coal.

Conclusions: Biomass-steam gasification for Waste-Green Hydrogen

- Green Hydrogen production through “Biomass- steam gasification” using advanced three stage gasifier is a technically and economically viable option.
- Biomass steam gasification will enable to reduce the targeted hydrogen production cost of Rs. 160/kg by 2025 itself (instead of 2030)
- Fertilizer industries will require about 4.6 lakh tonne (10 %) of green hydrogen in 2030
- Use of green hydrogen from biomass, in fertilizer industries can lead for circular economy, as the fertilizer goes to the field and agriculture residues comes to fertilizer production industries
- Low cost green hydrogen production from biomass can lead to low fertilizer cost and to reduce cost of food product
- Green hydrogen from biomass waste is a complete energy solution for Power supply, clean transport and other industrial applications.

Thank You

Contact e-mail:
praman@cleanenergyee.com
cenergy365@gmail.com

Website:
https://cleanenergyee.com/