Country Update – India

Gasification of Biomass and Waste

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IEA Bioenergy : Task 33 meeting

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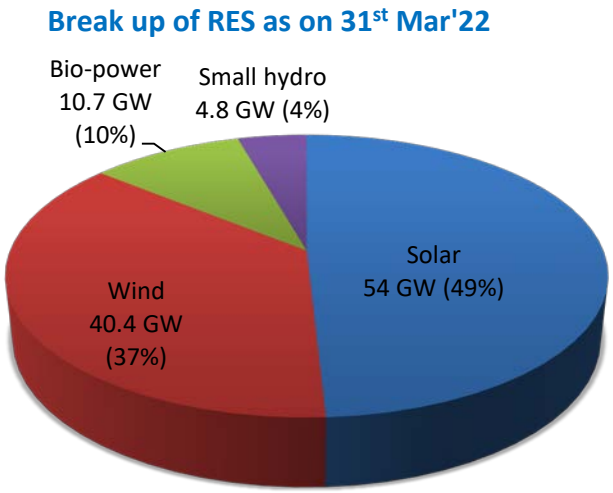
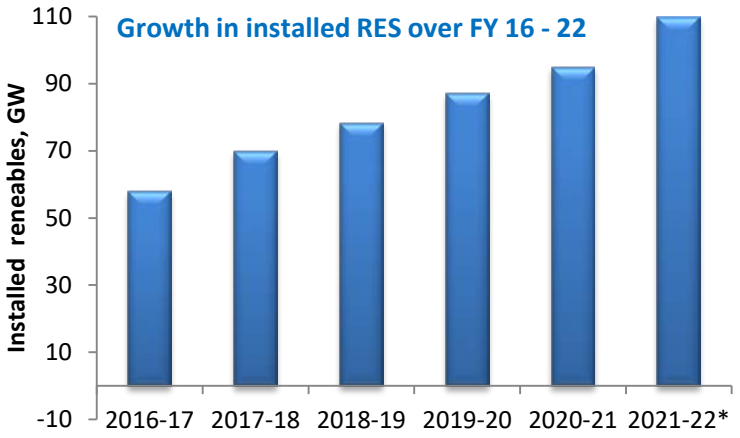
Outline

- Share of bioenergy in India's energy basket
- Bioenergy potential
- Biomass co-firing in coal based power plants
- National green hydrogen mission
- Biomass gasification status
- Biomass gasification based hydrogen generation

Share of bioenergy in India's energy basket

- Total primary energy demand in 2020 : ~880 MTOE
  - Share of bio-energy : ~20%
- Installed power capacity as on Mar'22 : ~400 GW
  - ➢ Share of RES: ~ 27% (109.9 GW)
  - ➢ Biomass 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





Source : https://cea.nic.in/installed-capacity-report/?lang=en

Share of bioenergy in different sectors in 2019

Sector	Share of bioenergy	Share of renewable energy	Overall consumption
Electricity	2.9%	20.7% (10.5% hydro)	1637 TWh (5894 PJ)
Transport energy (final consumption)	1.0%	1.3%	4396 PJ
Overall fuel and heat consumption	Direct biomass: 43.7%	44.0%	14629 PJ
Total final energy consumption	**26.0%**	**31.0%**	**24838 PJ**

Source: IEA World Energy Balances and Renewables Information, 2021

Bio-energy potential in India

As per a study sponsored by MNRE, the current availability of biomass in India is estimated at about ~750 million metric tons per year with surplus availability of at about 230 million metric tons per annum equivalent to potential of about 28 GW

Source	Area (kHa)	Biomass generation (MT/yr)	Surplus biomass (MT/yr)	Power potential (GW)
Crop residue	107760.7	682	178	23
Forest and waste lands	60000	155	104	14.5
Bagasse based cogeneration	550 sugar mills		87	14
Municipal Solid Waste			60	5.7
Total potential				**~ 55**

Source: Ministry of New & Renewable Energy

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
- National mission on biomass co-firing - SAMARTH (Sustainable Agrarian Mission on use of Agro Residue in Thermal Power Plants)
- India's coal-based power plants co-fired 59,000 tonnes of biomass cumulatively, as on Jan'22
- Tenders for 12 million tonnes of biomass are at different stages of process for short term & long term duration
- NTPC emerged as a leader in biomass user having co-fired approx. 58,000 MT of biomass
- While tendering for total biomass of 10.7 MMT over short-term and long-term basis
- Results are encouraging and there is still a long way to go before to achieve the target of 5-10% co-firing in all plants in the country

Source : https://pib.gov.in/PressReleasePage.aspx?PRID=1790832

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
- MNRE to develop single portal for carrying out all the activities including statutory clearances in a time bound manner
- Govt. has plans to bring down cost of green hydrogen to Rs 160 per kg by 2029-30

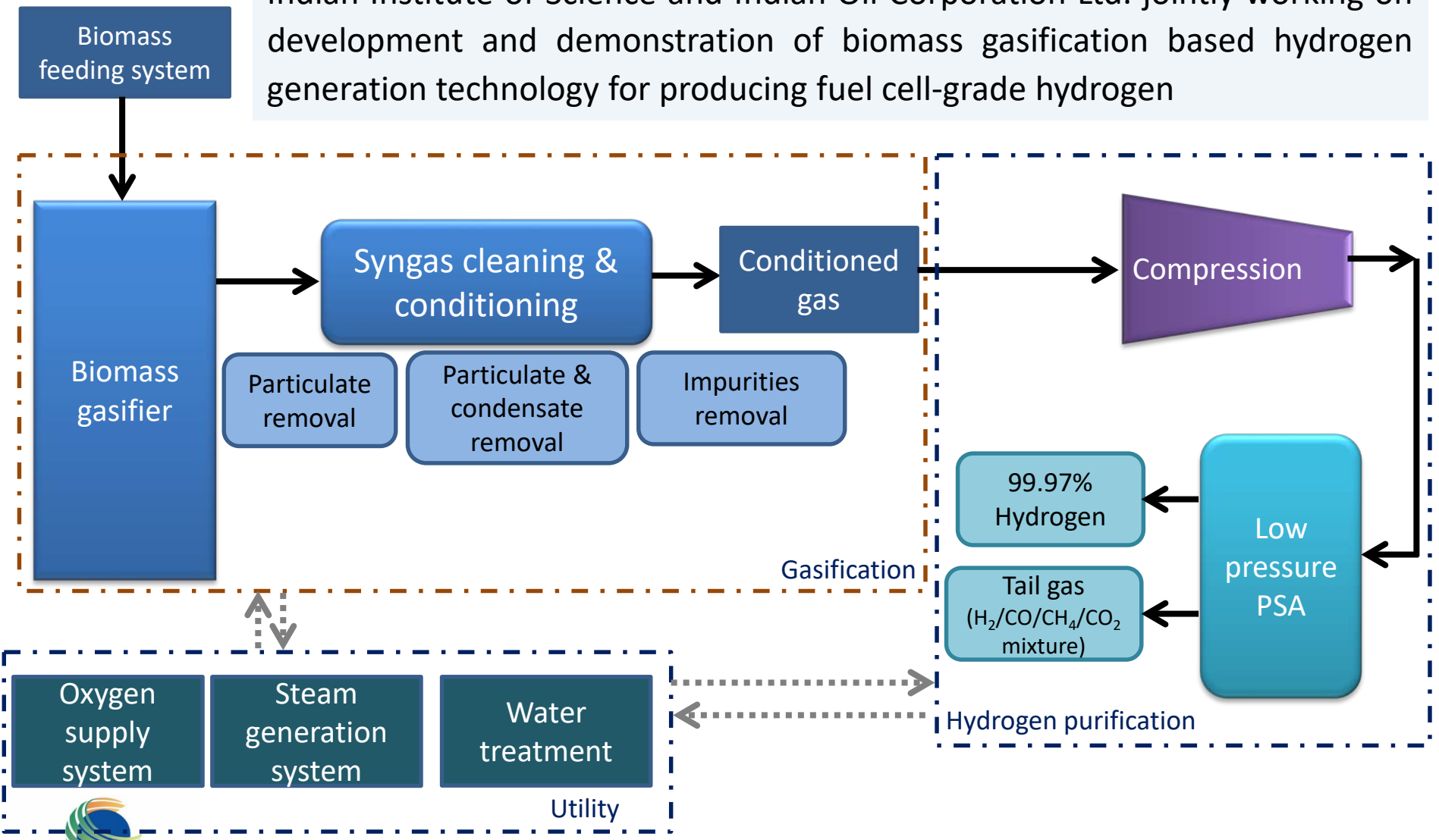
Source : Green hydrogen policy, No. 23/02/2022-R&R, GOI, Ministry of power , 17th February, 2022

Biomass gasification

- Several research institutions, industries and implementing agencies actively involved in development and deployment of biomass gasification in India during 1990-2010
- Quite a large no of biomass gasifiers set up to cater thermal and power requirements
- Power range 10 kWe – 2 MWe and thermal gasifier with 25 kW_{th}-5MW_{th} successfully deployed
- Since 2010, focus on biomass gasification based power generation reduced significantly
- Currently 10 - 12 biomass gasifier manufacturers available
- No major development

Biomass gasification based hydrogen generation

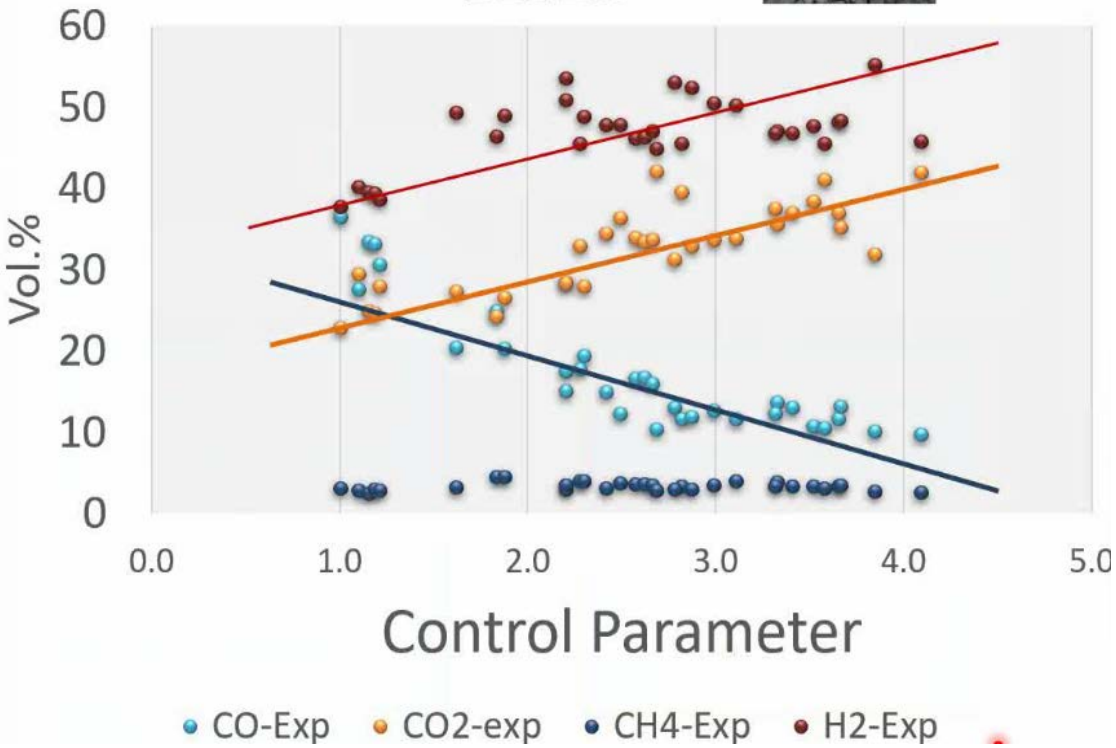
Indian Institute of Science and Indian Oil Corporation Ltd. jointly working on development and demonstration of biomass gasification based hydrogen generation technology for producing fuel cell-grade hydrogen



IEA Bioenergy
Technology Collaboration Programme

Oxy-steam gasification results





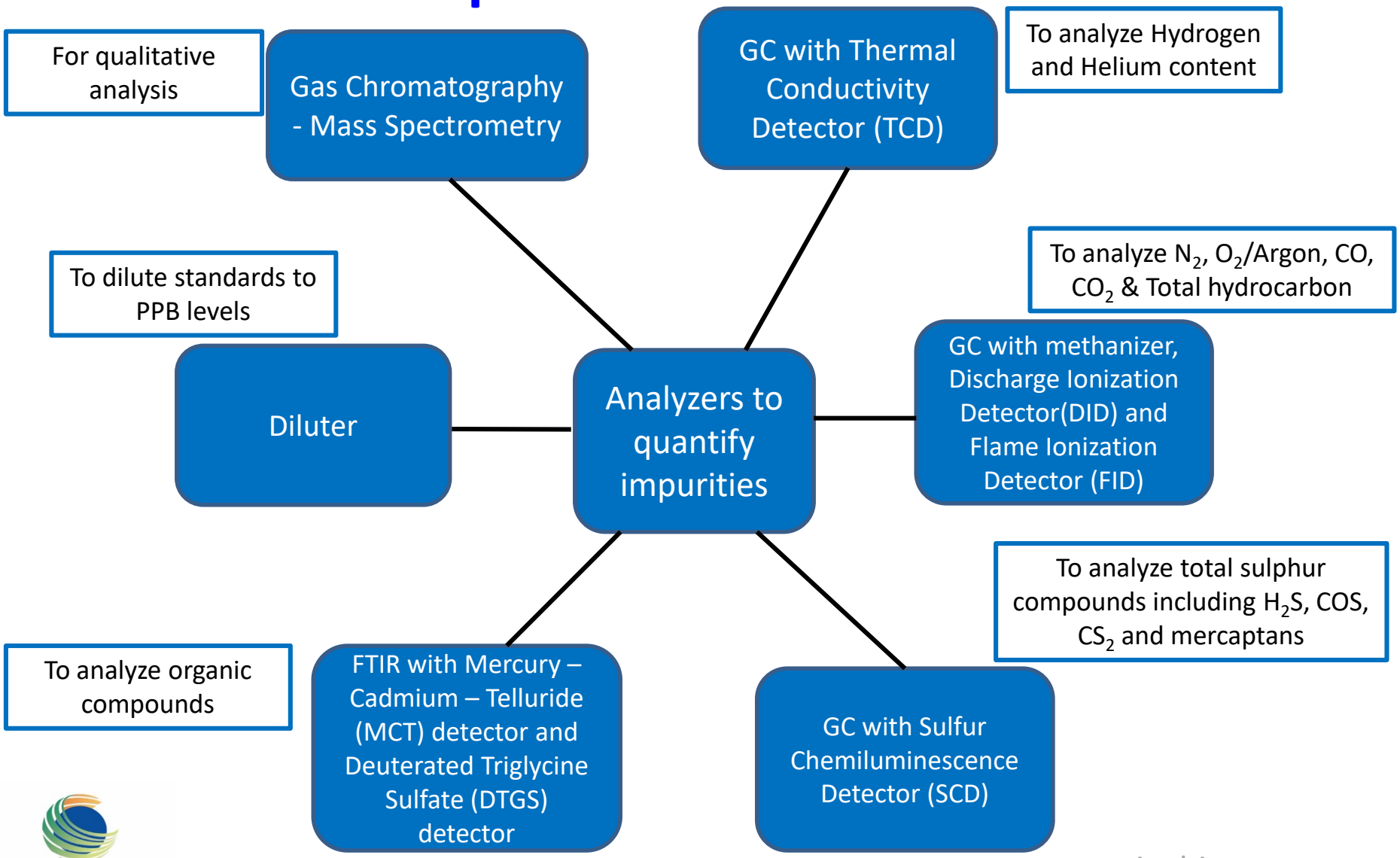
	Casuarina (CP 1.9)	Coconut shells (CP 1.8)
H_2	48.9± 2	44.1
CO	20.2± 1.5	23.2
CH_4	4.4± 0.8	3.6
CO_2	26.5± 2.1	29

	Casuarina (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

Oxy-steam gasification results

SBR	0.75	1	1.4	1.5	1.8	2.4	2.7
ER	0.21	0.18	0.21	0.23	0.27	0.28	0.3
H_2 yield (g/kg biomass)	66	68	71	73	94	99	104
H_2 yield (vol %) on dry basis	41.8	45.2	43.1	45.2	49.6	51.6	50.5
CO yield (vol %) on dry basis	27.6	24.9	26.5	24.9	17	12.4	13
H_2/CO ratio	1.5	1.8	1.6	1.8	2.9	3.8	3.9
LHV (MJ Nm^{-3})	8.9	8.6	8.8	8.7	8	7.4	7.4
Hydrogen efficiency (%)	73.7	63.2	67.2	63.5	70.5	61	63.7
Gasification efficiency (%)	85.8	76.8	80.8	77	79.5	70.5	71.5

Analytical systems for quantification of impurities specified under ISO



Specification of bio-hydrogen for PEM fuel cell

Standard reference	ISO-14687	Status
Characteristics (assay)	Type I, Type II, Grade D	
Hydrogen fuel index (minimum mole fraction)	>99.97%	Achieved
Total non-hydrogen gases	<300 µmol/mol	Achieved
Maximum concentration of impurities		
Water(H_2O)	<5 µmol/mol	
Total hydrocarbons expect CH_4 (C1 basis)	<2 µmol/mol	Achieved
Methane (CH_4)	100 µmol/mol	Achieved
Oxygen (O_2)	<5 µmol/mol	Achieved
Helium (He)	<300 µmol/mol	Achieved
Nitrogen (N_2)	<300 µmol/mol	Achieved
Argon (Ar)	<300 µmol/mol	Achieved
Carbon dioxide (CO_2)	<2 µmol/mol	Achieved
Carbon monoxide (CO)	<0.2 µmol/mol	Achieved
Total sulphur compounds (S1 equivalent)	<0.004 µmol/mol	Achieved
Formaldehyde (HCHO)	<0.2 µmol/mol	
Formic acid (HCOOH)	<0.2 µmol/mol	
Ammonia (NH_3)	<0.1 µmol/mol	
Total halogenated compounds (Halogen ion equivalent)	<0.05 µmol/mol	
Maximum particulates concentration	<1 mg/kg	Achieved

Thank You