BIRD RENEWABLES

HHO GAS, TUBE-X ENGINE, BOILER & BURNER TECHNICAL HANDBOOK

For customer discussions, scientific explanation, boiler fuel calculation, and black-box validation preparation

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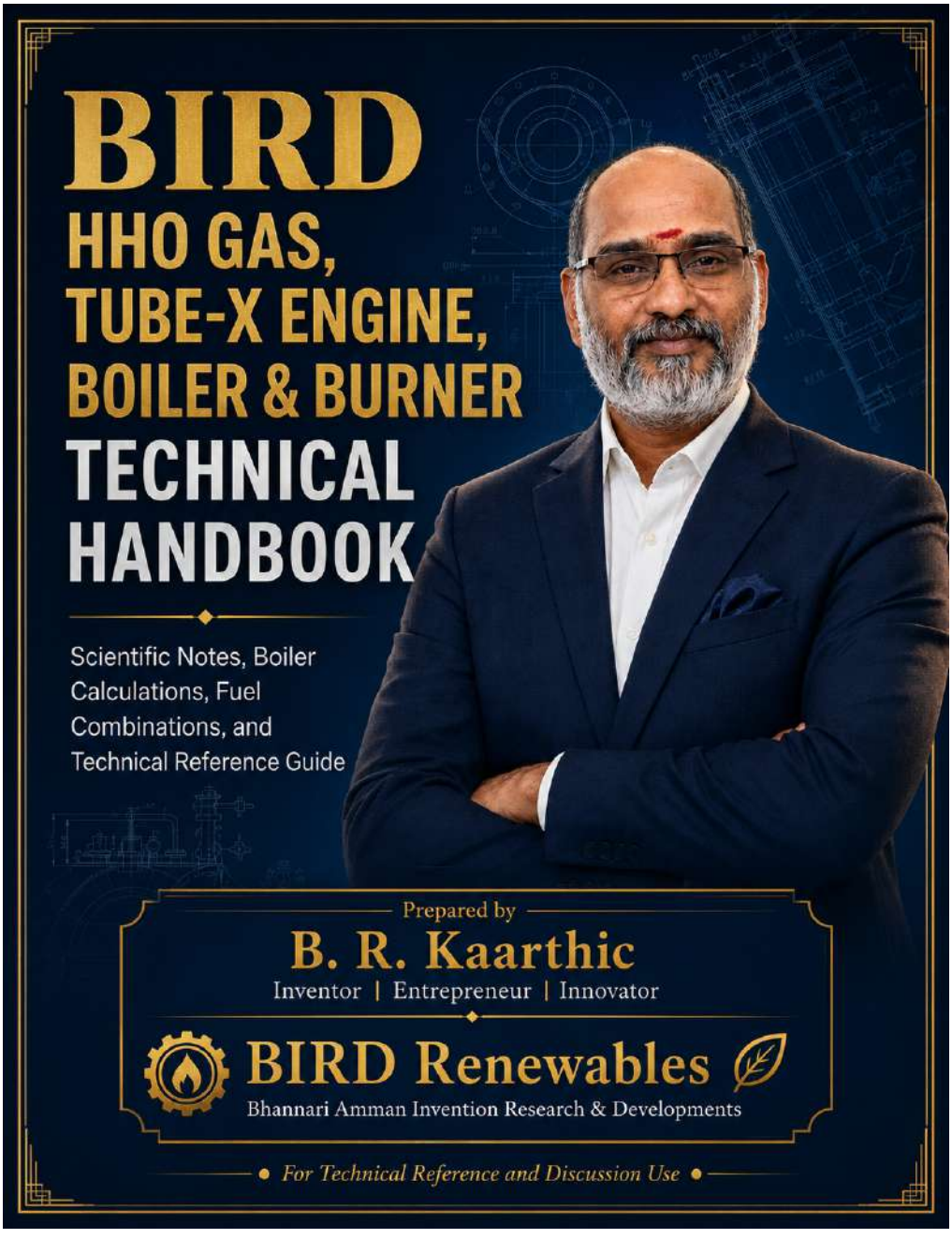
Version: Working Technical Notes for Print Handbook

Note: This handbook uses approximate engineering calculation values. Final commercial performance must be validated at site by calibrated instruments and qualified boiler/burner engineers.



Important Safety and Technical Disclaimer

- HHO gas / oxyhydrogen gas is highly reactive and can create flashback or explosion risk if handled wrongly.
- HHO should be generated on-demand only. Do not store HHO in cylinders. Do not compress HHO unless a certified system is designed and approved.
- Do not premix HHO with diesel, LPG, PNG, CNG, LDO, or other fuels in any storage tank.
- Use separate fuel lines, flashback arrestor, non-return valve, flame arrestor, pressure relief, leak sensor, flame sensor, emergency shutoff, and boiler interlock.
- Final burner design, fuel-air tuning, gas train, and boiler integration must be done only by a qualified boiler/burner engineer.
- All Tube-X internal design, IP-treated water formula, electrode/tube geometry, treatment method, controller logic, and manufacturing method are confidential BIRD trade secrets.

Table of Contents

1. HHO Gas Basic Identity and Composition

HHO gas is also called oxyhydrogen gas or Brown gas. It is a hydrogen-oxygen gas mixture generated from water through electrochemical or proprietary water-assisted gas generation processes. In BIRD documents, it must be described as on-demand HHO gas.

Parameter	Value
Gas name	HHO Gas / Oxyhydrogen Gas / Brown Gas
Production method	On-demand water electrolysis / Tube-X IP-treatedwater assisted HHO generation
Main gases	Hydrogen H2 and Oxygen O2
Volume ratio	H2 : O2 = 2 : 1
Hydrogen volume share	66.67%
Oxygen volume share	33.33%
Storage recommendation	On-demand only; not for storage or compression without certified system
Common applications	Boiler burner support, furnace support, engine carbon cleaning, industrial combustion support

Safe technical wording

BIRD HHO gas is an on-demand hydrogen-oxygen gas mixture generated from water, having approximately 2:1 hydrogen to oxygen ratio by volume. It is used as a high-reactivity combustion-support gas with proper safety interlocks and certified burner integration.

2. Density, Weight, and Volume of HHO Gas

HHO gas density changes with temperature and pressure. At normal atmospheric pressure, density becomes lower when temperature increases.

Condition	Approx. Density	Approx. Volume
0 deg C, 1 atm	0.536 kg/m3	1 kg HHO = approx. 1,865 litres
25 deg C, 1 atm	0.49 kg/m3	1 kg HHO = approx. 2,035 litres
30 deg C, 1 atm	0.48 kg/m3	1 kg HHO = approx. 2,070 litres
Practical business calculation	0.49 to 0.54 kg/m3	Use 1 kg HHO = 1,850 to 2,000 litres

For simple boiler calculations in previous notes, we used 1 kg HHO = 1,850 litres. For Indian room temperature, 1 kg HHO may be closer to 2,000 litres. Use one method consistently in one proposal.

3. HHO Calorific Value / Heat Value

The practical engineering value used in our notes is: 1 kg HHO mixed gas = approx. 3,200 kcal and 1 litre HHO = approx. 1.73 kcal.

HHO Output / Quantity	Approx. Heat Value
1 kg HHO mixed gas	3,200 kcal approx.
1 litre HHO mixed gas	1.73 kcal approx.
1,000 LPH HHO	1,730 kcal/hr
10,000 LPH HHO	17,300 kcal/hr
50,000 LPH HHO	86,500 kcal/hr
1,00,000 LPH HHO	1,73,000 kcal/hr
5,00,000 LPH HHO	8,65,000 kcal/hr
7,80,000 LPH HHO	13,49,400 kcal/hr approx.

Formula

HHO heat in kcal/hr = HHO LPH x 1.73

Required HHO LPH = Required kcal/hr / 1.73

4. Pure Hydrogen Comparison

Pure hydrogen has much higher heat value by weight than HHO because pure hydrogen contains only fuel gas. HHO includes oxygen, and oxygen supports combustion but does not add fuel heat.

Parameter	Value
1 kg pure Hydrogen H2 - LHV	28,700 kcal approx.
1 kg pure Hydrogen H2 - HHV	33,900 kcal approx.
1 kg pure Hydrogen H2 volume	11,100 litres approx.
1 litre pure Hydrogen H2	2.59 kcal approx.
1 kg HHO mixed gas	3,200 kcal approx.
1 litre HHO mixed gas	1.73 kcal approx.

5. Why HHO kcal/kg Looks Lower

This is an important scientific answer when any customer or scientist asks why HHO kcal/kg is lower than pure hydrogen.

Point	Explanation
HHO volume ratio	H2 : O2 = 2 : 1
By volume	66.67% Hydrogen and 33.33% Oxygen
By weight	Approx. 11.11% Hydrogen and 88.89% Oxygen
Heat-producing part	Only Hydrogen gives fuel heat
Oxygen role	Oxygen supports burning but is not a fuel

Calculation: In 1 kg HHO mixed gas, hydrogen mass is approx. 0.111 kg. Pure hydrogen LHV is approx. 28,700 kcal/kg. Therefore 0.111 x 28,700 = about 3,185 kcal. This is why 1 kg HHO is taken as about 3,200 kcal.

Short answer: HHO kcal/kg is lower than pure hydrogen because almost 89% of HHO weight is oxygen. HHO advantage is high reactivity, fast flame support, built-in oxygen support, clean combustion support, and dual-fuel burner assistance.

6. Tube-X Engine Technical Positioning

The user stated that Tube-X engine design is different from conventional electrolysis and works with IP-treated water. Therefore, safe wording must not say it is only conventional electrolysis.

Item	Safe Data Sheet Wording
Technology name	Tube-X Robot Electrolyser Engine / Tube-X HHO Engine
Technology type	Proprietary IP-treated-water assisted HHO generation system
Not ordinary claim	Not described as normal electrolysis only
Internal R&D claim wording	Up to 4,880 LPH per kWh under controlled Tube-X IPtreated-water conditions
Commercial safe wording	Final output subject to calibrated black-box validation and safety certification
Confidential items	IP-treated water formula, internal geometry, treatment method, electrodes/tubes, controller logic, manufacturing method

Best public wording

Tube-X Engine is a proprietary IP-treated-water assisted HHO generation system, not a conventional electrolyser. Internal R&D test output may reach up to 4,880 LPH per kWh under controlled Tube-X operating conditions. Commercial rating will be confirmed through calibrated black-box validation.

7. Conventional Electrolysis Scientific Limit

If somebody asks why normal HHO machines show around 450 LPH/kWh, explain this clearly. Normal electrolysis is limited by Faraday law and energy conservation.

Question	Answer
Conventional scientific range	Approx. 423 to 500 LPH HHO per kWh
Common practical statement	Approx. 450 LPH HHO per kWh
Reason	Water splitting needs energy; 1 kWh cannot produce 9 kWh of gas heat by normal electrolysis alone
High-output claim safety	Must be explained as IP-treated-water assisted system and validated by black-box test

Do not publicly say: 4,880 LPH per kWh by normal electrolysis. Better say: up to 4,880 LPH per kWh under proprietary IP-treated-water operating conditions, subject to validation.

8. Common Reasons for Wrong High LPH Reading

- Gas mixed with water vapour or steam
- Air leakage entering gas line
- Foam or electrolyte mist entering flow meter
- Rotameter not calibrated for HHO gas
- Pressure and temperature not corrected
- Pulsing gas output affecting meter reading
- Stored gas inside tank or pipe counted in test
- Wet gas measured instead of dry gas
- Full input power not measured: rectifier loss, pump, cooling, control panel not included
- Gas leakage and back pressure fluctuation

9. Black-Box Validation Protocol

Validation can check performance, but nobody should see secret technology. This must be written in every testing plan.

Validation Item	Requirement
Allowed to test	Gas output LPH, input power, water consumption, H2/O2 ratio, pressure, temperature, stability, safety system
Not allowed	Opening machine, internal photos, drawings, electrode design, IP water formula, coating/treatment, controller logic, manufacturing method
Before testing	NDA signed, no opening clause, no photography inside, your person present, continuous video recording
Meters needed	Calibrated dry gas flow meter, AC power meter, DC power meter, pressure gauge, temperature meter, water consumption measurement
Report must mention	Date, time, pressure, temperature, full power load, gas output, water use, operating condition, witness names

Black-box test statement: The testing party is permitted to verify input power, gas output, water consumption, pressure, temperature, and stability only. Internal technology, drawings, IP-treated water formula, software, and manufacturing method are confidential and shall not be inspected, copied, photographed, or disclosed.

Tube-X R&D Test Sheet Template

Test Field	Reading / Notes
Engine name	Tube-X HHO Engine / Module No. ____
Date and place	_____
Input voltage	_____
Input current	_____
Total AC power kW	_____
Total DC power kW	_____
Running time	1 hr / 4 hr / 8 hr / 24 hr
Gas output LPH	_____
Flow meter model / calibration	_____
Water consumption L/hr	_____
Pressure	_____
Temperature	_____
Gas ratio / gas test	H2/O2 approx. 2:1
Witness	Engineer / advocate-side witness / customer representative
Video proof	Yes / No

10. Water Consumption

Water consumption reference used by BIRD notes: 10,000 LPH HHO requires approx. 5.6 litres water per hour.

HHO Output	Approx. Water Consumption
10,000 LPH	5.6 L/hr
50,000 LPH	28 L/hr
1,00,000 LPH	56 L/hr
3,00,000 LPH	168 L/hr
5,00,000 LPH	280 L/hr
6,24,000 LPH	350 L/hr approx.
7,00,000 LPH	392 L/hr approx.
7,80,000 LPH	437 L/hr approx.

Formula: Water consumption L/hr = HHO LPH / 10,000 x 5.6

11. Power Requirement Based on Engine Reference

Power requirement depends on actual engine output per kWh and total system load. Keep all power calculation transparent.

Reference	Output
Conventional HHO reference	450 LPH per kWh
Previous commercial reference	1,440 LPH per kWh
Tube-X safe proposal reference	2,880 LPH per kWh
Tube-X internal R&D claim	4,880 LPH per kWh under IP-treated-water conditions

Power for 7 lakh LPH

Engine Reference	Power for 7,00,000 LPH
450 LPH/kWh	1,556 kW approx.
1,440 LPH/kWh	486 kW approx.
2,880 LPH/kWh	243 kW approx.

4,880 LPH/kWh	143 kW approx.

12. Boiler Heat Calculation Formula

For all boiler fuel calculations, first decide total heat requirement in kcal/hr, then subtract HHO heat support, then calculate balance fuel.

Calculation	Formula
HHO heat	HHO LPH x 1.73 = kcal/hr
Required HHO	Required kcal/hr / 1.73 = HHO LPH
Diesel fuel	Balance kcal/hr / 8,500 = litre/hr
LDO / light oil	Balance kcal/hr / 9,000 = litre/hr
LPG	Balance kcal/hr / 11,000 = kg/hr
PNG	Balance kcal/hr / 8,500 = SCM/hr
CNG	Balance kcal/hr / 12,000 = kg/hr
Wood	Balance kcal/hr / 3,000 = kg/hr

13. 2 Ton Boiler Basic Requirement

Working assumption used in our calculations: 2 ton package boiler requires approx. 13,50,000 kcal/hr heat input for steam production around 10.5 bar. Actual value can vary with boiler efficiency, feed water temperature, blowdown, steam dryness, burner tuning, and site condition.

Item	Value
Boiler capacity	2 ton / 2 TPH steam
Steam pressure reference	10.5 bar
Heat requirement used	13,50,000 kcal/hr
100% HHO required	13,50,000 / 1.73 = 7,80,347 LPH
HHO kg/hr	13,50,000 / 3,200 = 421.87 kg/hr
Water for 100% HHO	Approx. 437 L/hr

14. 2 Ton Boiler - HHO + PNG Combinations

Combination	HHO Heat kcal/hr	HHO Required	PNG Required
50% HHO + 50% PNG	675,000	3.90 lakh LPH	79.4 SCM/hr
60% HHO + 40% PNG	810,000	4.68 lakh LPH	63.5 SCM/hr
70% HHO + 30% PNG	945,000	5.46 lakh LPH	47.6 SCM/hr
80% HHO + 20% PNG	1,080,000	6.24 lakh LPH	31.8 SCM/hr
7 lakh LPH HHO + PNG balance	1,211,000	7.00 lakh LPH	16.4 SCM/hr

Recommended staged trial: start with lower HHO support, tune burner, measure steam, then increase HHO after stable combustion and safety confirmation.

15. 2 Ton Boiler - Fixed HHO Input with Diesel Balance

HHO Input	HHO Heat	Balance Heat	Diesel Balance
1.0 lakh LPH	173,000	1,177,000	138.5 L/hr
2.0 lakh LPH	346,000	1,004,000	118.1 L/hr
3.0 lakh LPH	519,000	831,000	97.8 L/hr
4.0 lakh LPH	692,000	658,000	77.4 L/hr
5.0 lakh LPH	865,000	485,000	57.1 L/hr
6.0 lakh LPH	1,038,000	312,000	36.7 L/hr
7.0 lakh LPH	1,211,000	139,000	16.4 L/hr
7.8 lakh LPH	1,349,400	600	0.1 L/hr

16. 2 Ton Boiler - 1 Lakh LPH HHO + Main Fuel Balance

1 lakh LPH HHO gives approx. 1,73,000 kcal/hr. Balance heat for 2 ton boiler = 13,50,000 - 1,73,000 = 11,77,000 kcal/hr.

Main Fuel	Heat Value Used	Fuel Needed with 1 lakh LPH HHO

Diesel	8,500 kcal/litre	138 L/hr approx.
LDO / Light Oil	9,000 kcal/litre	131 L/hr approx.
LPG	11,000 kcal/kg	107 kg/hr approx.
PNG	8,500 kcal/SCM	138 SCM/hr approx.
CNG	12,000 kcal/kg	98 kg/hr approx.
Wood	3,000 kcal/kg	392 kg/hr approx.

17. Fuel Heat Value List

Fuel / Compound	Formula / Composition	State	Approx. Heat Value
HHO mixed gas	H2 + O2 mixture	Gas	1.73 kcal/litre / 3,200 kcal/kg
Pure Hydrogen	H2	Gas	28,700 kcal/kg LHV
Methane	CH4	Gas	12,000 kcal/kg
Ethane	C2H6	Gas	11,300 kcal/kg
Propane	C3H8	Gas / LPG	11,900 kcal/kg
Butane	C4H10	Gas / LPG	11,800 kcal/kg
LPG	Propane + Butane mix	Gas/liquid under pressure	11,000 kcal/kg
CNG	Mainly methane	Gas	12,000 kcal/kg
PNG	Mainly methane	Gas pipeline	8,500 kcal/SCM
Petrol / Gasoline	Approx. C8H18 mixture	Liquid	10,500-11,000 kcal/kg
Octane	C8H18	Liquid	10,700 kcal/kg
Hexane	C6H14	Liquid	10,700 kcal/kg
Heptane	C7H16	Liquid	10,600 kcal/kg
Benzene	C6H6	Liquid	9,700 kcal/kg - toxic/carcinogenic
Toluene	C7H8	Liquid	10,100 kcal/kg
Xylene	C8H10	Liquid	10,200 kcal/kg
Kerosene	C10-C16 mix	Liquid	10,300 kcal/kg approx.
Diesel	C10-C22 hydrocarbon mix	Liquid	8,500 kcal/litre / 10,200 kcal/kg
Light Diesel Oil / LDO	Hydrocarbon mix	Liquid	9,000 kcal/litre
Furnace Oil	Heavy hydrocarbon mix	Liquid	9,500-10,200 kcal/kg
Naphtha	C5-C12 mix	Liquid	10,500 kcal/kg
Waste oil / used oil	Hydrocarbon mix	Liquid	8,500-9,500 kcal/litre

Important correction: Diesel is not CH4. CH4 is methane gas. Diesel is a mixture of hydrocarbons, commonly approximated around C12H23 or C10-C22 mixture.

18. Best HHO Combination for kcal and Economy

The best combination depends on fuel availability, local price, burner compatibility, and boiler type.
For clean industrial boilers, HHO + PNG is generally the best first choice if PNG pipeline is available.

Rank	Combination	Economy / Technical Note	Suggestion
1	HHO + PNG	Best clean + economy if PNG available	Recommended for industrial boiler
2	HHO + CNG	Clean, good control, higher cost than PNG	Good if no PNG pipeline
3	HHO + LDO / Light Oil	Good control for existing oil burner	Best for trial / retrofit
4	HHO + Diesel	Easy to test, costly running	Use for short trial
5	HHO + LPG	Clean but usually costly	Use only if site already uses LPG
6	HHO + Wood	Fuel may be cheap but ash, smoke, labour and maintenance high	Not best for clean HHO project

Customer-safe line: For clean and economical boiler operation, HHO + PNG is preferred where PNG is available. Final fuel saving shall be confirmed only after site trial, flue gas analysis, steam output measurement, and certified boiler/burner tuning.

19. 2 Ton to 12 Ton Boiler - Heat Requirement Chart

Boiler Capacity	Heat Required	100% HHO Required
2 ton	1,350,000 kcal/hr	7.80 lakh LPH
3 ton	2,025,000 kcal/hr	11.71 lakh LPH
4 ton	2,700,000 kcal/hr	15.61 lakh LPH
5 ton	3,375,000 kcal/hr	19.51 lakh LPH
6 ton	4,050,000 kcal/hr	23.41 lakh LPH
7 ton	4,725,000 kcal/hr	27.31 lakh LPH
8 ton	5,400,000 kcal/hr	31.21 lakh LPH
9 ton	6,075,000 kcal/hr	35.12 lakh LPH
10 ton	6,750,000 kcal/hr	39.02 lakh LPH
11 ton	7,425,000 kcal/hr	42.92 lakh LPH
12 ton	8,100,000 kcal/hr	46.82 lakh LPH

20. 2 Ton to 12 Ton Boiler - With Fixed 1 Lakh LPH HHO Support

In this chart, fixed HHO input is 1,00,000 LPH. HHO heat = 1,73,000 kcal/hr. Balance fuel is calculated for each boiler size.

Boiler	Total kcal/hr	Balance after HHO	Diesel	LDO	LPG	PNG	CNG	Wood
2 ton	1,350,000	1,177,000	138 L/hr	131 L/hr	107 kg/hr	138 SCM/hr	98 kg/hr	392 kg/hr
3 ton	2,025,000	1,852,000	218 L/hr	206 L/hr	168 kg/hr	218 SCM/hr	154 kg/hr	617 kg/hr
4 ton	2,700,000	2,527,000	297 L/hr	281 L/hr	230 kg/hr	297 SCM/hr	211 kg/hr	842 kg/hr
5 ton	3,375,000	3,202,000	377 L/hr	356 L/hr	291 kg/hr	377 SCM/hr	267 kg/hr	1067 kg/hr
6 ton	4,050,000	3,877,000	456 L/hr	431 L/hr	352 kg/hr	456 SCM/hr	323 kg/hr	1292 kg/hr
7 ton	4,725,000	4,552,000	536 L/hr	506 L/hr	414 kg/hr	536 SCM/hr	379 kg/hr	1517 kg/hr
8 ton	5,400,000	5,227,000	615 L/hr	581 L/hr	475 kg/hr	615 SCM/hr	436 kg/hr	1742 kg/hr
9 ton	6,075,000	5,902,000	694 L/hr	656 L/hr	537 kg/hr	694 SCM/hr	492 kg/hr	1967 kg/hr
10 ton	6,750,000	6,577,000	774 L/hr	731 L/hr	598 kg/hr	774 SCM/hr	548 kg/hr	2192 kg/hr
11 ton	7,425,000	7,252,000	853 L/hr	806 L/hr	659 kg/hr	853 SCM/hr	604 kg/hr	2417 kg/hr
12 ton	8,100,000	7,927,000	933 L/hr	881 L/hr	721 kg/hr	933 SCM/hr	661 kg/hr	2642 kg/hr

21. 2 Ton to 12 Ton Boiler - HHO Share Planning Chart

This chart helps choose HHO percentage for different boiler sizes. HHO LPH = total heat x percentage / 1.73.

Boiler	50% HHO	60% HHO	70% HHO	80% HHO	100% HHO
2 ton	3.90 lakh LPH	4.68 lakh LPH	5.46 lakh LPH	6.24 lakh LPH	7.80 lakh LPH
3 ton	5.85 lakh LPH	7.02 lakh LPH	8.19 lakh LPH	9.36 lakh LPH	11.71 lakh LPH
4 ton	7.80 lakh LPH	9.36 lakh LPH	10.92 lakh LPH	12.49 lakh LPH	15.61 lakh LPH

5 ton	9.75 lakh LPH	11.71 lakh LPH	13.66 lakh LPH	15.61 lakh LPH	19.51 lakh LPH
6 ton	11.71 lakh LPH	14.05 lakh LPH	16.39 lakh LPH	18.73 lakh LPH	23.41 lakh LPH
7 ton	13.66 lakh LPH	16.39 lakh LPH	19.12 lakh LPH	21.85 lakh LPH	27.31 lakh LPH

8 ton	15.61 lakh LPH	18.73 lakh LPH	21.85 lakh LPH	24.97 lakh LPH	31.21 lakh LPH
9 ton	17.56 lakh LPH	21.07 lakh LPH	24.58 lakh LPH	28.09 lakh LPH	35.12 lakh LPH
10 ton	19.51 lakh LPH	23.41 lakh LPH	27.31 lakh LPH	31.21 lakh LPH	39.02 lakh LPH
11 ton	21.46 lakh LPH	25.75 lakh LPH	30.04 lakh LPH	34.34 lakh LPH	42.92 lakh LPH
12 ton	23.41 lakh LPH	28.09 lakh LPH	32.77 lakh LPH	37.46 lakh LPH	46.82 lakh LPH

22. 7 Lakh LPH HHO Plan for 2 Ton Boiler

For 2 ton boiler heat requirement 13,50,000 kcal/hr:

Item	Value
HHO planned	7,00,000 LPH
HHO heat	7,00,000 x 1.73 = 12,11,000 kcal/hr
Balance heat required	13,50,000 - 12,11,000 = 1,39,000 kcal/hr
PNG balance required	1,39,000 / 8,500 = 16.4 SCM/hr
Water consumption	7,00,000 / 10,000 x 5.6 = 392 L/hr approx.

Engine / Module Count

Case	Answer
If one engine is 4,880 LPH module	7,00,000 / 4,880 = 143.4, so use 144 engines/modules
If 4,880 LPH means efficiency per kWh	It means power about 144 kW, not engine count
If one industrial module is 50,000 LPH	7,00,000 / 50,000 = 14 modules
Practical industrial modular design	14 nos x 50,000 LPH modules = 7,00,000 LPH

23. Safety System Checklist for Boiler/Burner

Safety Item	Purpose
Flashback arrestor	Prevents flame travel back into gas line
Non-return valve	Prevents reverse flow
Water bubbler / safety trap	Secondary flashback protection
Flame arrestor	Flame safety barrier
Pressure relief valve	Protects against over-pressure
Pressure sensor	Monitors gas line pressure
Gas leak detector	Detects gas leakage
Flame sensor	Confirms flame presence
Solenoid shut-off valve	Automatic fuel/HHO cutoff
Emergency stop switch	Manual emergency shutdown
Boiler interlock	Stops gas if boiler unsafe
Low-water cut-off	Boiler dry-run protection
Over-pressure cut-off	Boiler pressure safety
Ventilation system	Prevents gas accumulation
Earthing and electrical protection	Electrical safety
Trained operator	Operation safety
Separate HHO and fuel lines	Avoids premixing and storage risk

24. Burner Integration Safe Statement

HHO gas shall be supplied as an on-demand auxiliary combustion gas through a controlled gas train with pressure regulation, non-return valve, flashback arrestor, flame arrestor, solenoid shut-off, gas sensor, flame sensor, pressure relief system, and boiler interlock. Diesel, LPG, PNG, CNG, or light oil shall be supplied through separate certified fuel lines. Final burner design, flame tuning, fuel-air ratio, and boiler integration must be validated by a qualified boiler/burner engineer.

25. Customer and Scientist Q&A

Q1. What is your HHO gas ratio?

H2 : O2 = 2 : 1 by volume. Hydrogen is 66.67% and oxygen is 33.33% by volume.

Q2. What is HHO density?

Approx. 0.536 kg/m3 at 0 deg C and 1 atm; approx. 0.49 kg/m3 at 25 deg C and 1 atm.

Q3. What is HHO heat value?

Approx. 3,200 kcal/kg or 1.73 kcal/litre for HHO mixed gas.

Q4. Why is HHO kcal/kg less than pure hydrogen?

Because HHO contains oxygen. By weight, only about 11.11% is hydrogen and about 88.89% is oxygen. Only hydrogen gives fuel heat.

Q5. Is diesel CH4?

No. CH4 is methane. Diesel is a hydrocarbon mixture around C10-C22, sometimes approximated as C12H23.

Q6. Which combination is best for economy?

HHO + PNG is best if PNG is available. HHO + CNG is second. HHO + LDO/diesel is easier for trial but costly.

Q7. Can HHO be stored?

No. HHO should be generated on-demand only. Storage/compression is high risk unless certified system exists.

Q8. What is Tube-X claim wording?

Tube-X is a proprietary IP-treated-water assisted HHO generation system. Internal R&D test output may reach up to 4,880 LPH/kWh under controlled conditions, subject to black-box validation.

Q9. What proof is needed?

Calibrated dry gas flow meter, full AC/DC power measurement, water consumption, pressure, temperature, continuous video, and witness report.

Q10. For 2 ton boiler 80% HHO + 20% PNG, what is required?

Approx. 6.24 lakh LPH HHO and 32 SCM/hr PNG for 13.5 lakh kcal/hr heat requirement.

26. Quick Reference Summary

Item	Quick Value
HHO ratio	H2 : O2 = 2 : 1 by volume
HHO volume percentage	66.67% H2 and 33.33% O2
HHO weight percentage	Approx. 11.11% H2 and 88.89% O2
HHO density	0.49 kg/m3 at 25 deg C, 1 atm approx.
HHO heat value	1.73 kcal/litre and 3,200 kcal/kg approx.
Pure hydrogen heat value	28,700 kcal/kg LHV approx.
2 ton boiler heat reference	13,50,000 kcal/hr
2 ton boiler 100% HHO	7.8 lakh LPH approx.
2 ton 80% HHO + 20% PNG	6.24 lakh LPH HHO + 32 SCM/hr PNG approx.
2 ton 7 lakh LPH HHO + PNG balance	7 lakh LPH HHO + 16.4 SCM/hr PNG approx.
Water consumption reference	10,000 LPH HHO = 5.6 L/hr water
Best economy combination	HHO + PNG if available
Validation method	Black-box performance testing only
Main safety rule	On-demand only; no HHO storage; no premixing

27. Final Notes for BIRD Renewables

- Use safe scientific language in all customer documents.

- Do not reveal Tube-X internal design or IP-treated water formula.

- Do not promise fixed fuel saving without site trial and calibrated measurement.

- Keep HHO as auxiliary combustion-support gas in customer proposals.

- Use HHO + PNG as preferred economy route for clean boiler applications where PNG is available.

- Keep all test reports signed, dated, video recorded, and stored in BIRD R&D files.

Prepared as a print handbook for Mr. Bealur Ramalingam Kaarthic / BIRD Renewables.