

IRR Calculation Sheets

Region **Middle East 2**

Cost Breakdown (by Accounting Item: PL)

Assumptions			
NH3 Production per Year	1,000,000	t-NH3/y	
NH3 Production per Day	3,000	t-NH3/ d	
Operating Days per Year	333	d/y	
Facility Utilization Rate	100	%	8,000 Hours
Production Process	Second Generation ~ O2-ATR Method		
Feedstock and Energy	Natural gas (NG)		
Heat and Natural Gas Required per ton of NH3	9.0	Gcal /t-NH3	HHV
Natural Gas Input per Day	2,090	t-NG/d	HHV
Price of feedstock and Fuel	3.5	\$/MMBTU	HHV
CO2 Capture			
CO2 Emission per Ton of NH3	1.9	t-CO2/t-NH3	Raw Fuel Input
Captured Amount	3,975	t-CO2/d	Only SynGas
Capture Rate	70%	t-CO2/y	Ratio of Captured Amount to Total Emission
Investment		1,000US\$	
CAPEX			
ISBL	700,000		
OSBL*	350,000		*ISBLx50%
Additional Cost: 1) CO2 P/L	20,000		a
Additional Cost: 2) NH3 Loading	120,000		b
OSBL Subtotal	490,000		*+a+b
ISBL+OSBL	1,190,000		c
Contingency allowance	178,500	% of c	15%
Total	1,368,500		d
Cost reduction	-136,850	% of d	10%
Total	1,231,650		
(After LF Adjustment)	1,108,485	L/F (Using the U.S. as a reference)=	0.90
Owner's Cost	55,424	After LF Adjustment x	5%
Recalculated Total	1,163,909		
Years of Depreciation	15	Straight-line Depreciation	

Composition, Heating Value, and CO2 Emission of Natural Gas being used as Material and Fuel			
Composition (mol%)	CH ₄ :93.9%,C ₂ H ₆ :4.2%		
Higher Heating Value (HHV)	MJ/kg	54.1	Ratio of LHV to HHV
Lower Heating Value (LHV)	MJ/kg	48.8	90%
Average Molecular Weight (MW)	kg/kmol	16.8	
CO2 Emission	kg-CO2/NG-kg	2.72	

Assumptions			
Utility & Others			
Electric Power (Purchase)	17.0	MW/h	
Electric Power per Ton of NH3	136	kWh/t-NH3	
Industrial Water (Purchase)	32.2	1,000WT-t/d	
Industrial Water per Ton of NH3	10.7	WT-t/t-NH3	
Catalyst and Chemicals per Ton of NH3	6.1	US\$/t-NH3	
Personnel			
Field Manager 1)	2	persons = 2 persons/shift x 1 shift/day	
Shift Leader(MG)2)	4	persons = 1 persons/shift x 4 shift/day	
Field Operator3)	28	persons = 6 persons/shift x 4 shift/day	
Panel Operator4)	16	persons = 4 persons/shift x 4 shift/day	
Labo Technician5)	6	persons = 6 persons/shift x 1 shift/day	
Total	56	persons	

Cost Calculation (First Year) EIRR = 9.0%			
1. Fixed Cost			
Labor Cost (Operators)	persons	1,000\$/person	
Managers 1)+2)	6	120	
Panel Operators 4)+5)	22	60	
Field Operators 3)	28	60	
Subtotal	3.7	US\$/T-NH3	
Maintenance Cost ②	18.5	US\$/T-NH3	CAPEX x 1.5%
General & Administrative Expens	6.7	US\$/T-NH3	①x80%+②x20%
Utility cost	3.5	US\$/T-NH3	OSBL x 1.0%
Insurance and Indirect Tax	6.2	US\$/T-NH3	CAPEX x 0.5%
Total	38.5	US\$/T-NH3	
2. Variable Cost			
Natural gas (NG)	125.0	US\$/T-NH3	
Electric Power (Purchase)	6.8	US\$/T-NH3	0.05 US\$/kWh
Industrial Water (Purchase)	12.9	US\$/T-NH3	1.20 US\$/WT-t
Catalyst and Chemicals	6.1	US\$/T-NH3	
CO2 Transfer	-13.2	US\$/T-NH3	-10.0 US\$/t-CO2
Total	137.5	US\$/T-NH3	
Cash Cost (1+2)	176.1	US\$/T-NH3	

Export Price (FOB)	292.5	US\$/T-NH3	
Freight	42.0	US\$/T-NH3	FOB, Fuel Tanker
CIF Price in Japan	334.5	US\$/T-NH3	

	EIRR = 9.0%					
	1st Year	8th Year	13th Year	18th Year	20th Year	Average of 20 Years
Construction and Commissioning: 4 years						
The duration of the project is assumed to be 20 years.	2026	2033	2038	2043	2045	
Fixed Cost (US\$/t-NH3)	38.5	38.5	38.5	38.5	38.5	38.8
Labor Cost	3.7	3.7	3.7	3.7	3.7	3.8
Maintenance Cost	18.5	18.5	18.5	18.5	18.5	18.5
General Management Cost, Insurance, Tax, and Rent	16.3	16.3	16.3	16.3	16.3	16.5
Variable cost (US\$/t-NH3)	137.5	137.5	137.5	137.5	137.5	137.5
Cost of Natural Gas	125.0	125.0	125.0	125.0	125.0	125.0
Cost of CO2 Sequestration	-13.2	-13.2	-13.2	-13.2	-13.2	-13.2
Others	25.8	25.8	25.8	25.8	25.8	25.8
Depreciation & Interest (US\$/t-NH3)	102.1	90.7	82.5	0.0	0.0	68.0
Depreciation Expenses	77.6	77.6	77.6	0.0	0.0	58.2
Interest	24.6	13.1	4.9	0.0	0.0	9.8
Corporate Tax (US\$/t-NH3) *	2.9	5.1	6.8	23.3	23.3	9.7
Profit (after Tax)	11.4	20.6	27.1	93.1	93.1	38.5
(Equity share of depreciation added)	34.7	43.9	50.4	93.1	93.1	55.9
Export Price (FOB) (US\$/t-NH3)	292.5	292.5	292.5	292.5	292.5	292.5
Transportation (Freight)	42.0	42.0	42.0	42.0	42.0	42.0
CIF Price in Japan (US\$/t-NH3)	334.5	334.5	334.5	334.5	334.5	334.5

Cost Breakdown by Segment (First Year)	
	US\$/T-NH3
Purchase of Natural Gas	125.0
NH3 Production , CO2 Capture, etc.	180.7
CO2 Sequestration	-13.2
Export Price (FOB)	292.5
Transportation from Country of Production to Japan	42.0
CIF Price in Japan	334.5
	Yen/T-NH3
Unloading and Delivery	0.0
In-tank Price (User's Price)	35,792

= Default Input (Recommended Val)
 = Input for Sensitivity Analysis
 = Input for IRR sheet
 Exchange Rate Yen/US\$