

**IRR Calculation Sheets**

Region **North America**

**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	
Price of feedstock and Fuel	3.0	\$/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
	1,324,947	t-CO2/y	
Capture Rate	70%	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 )	1,231,650	L/F (Using the U.S. as a reference)=	1.00
Owner's Cost	61,583	After LF Adjustment x	5%
Recalculated Total	1,293,233		
Years of Depreciation	15	Straight-line Depreciation	

Composition, Heating Value, and CO2 Emission of Natural Gas being used as Material and Fuel		
Composition (mol%)	CH4:93.9%, C2H6:4.2%	
Higher Heating Value (HHV)	MJ/kg	54.1
Lower Heating Value (LHV)	MJ/kg	48.8
Average Molecular Weight (MW)	kg/kmol	16.8
CO2 Emission	kg-CO2/NG-kg	2.72

Ratio of LHV to HHV 90%

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	

Cash Cost Calculation (First Year) EIRR = 9.0%			
<b>1. Fixed Cost</b>			
Labor Cost (Operators)	persons	1,000\$/person	
Managers 1)+2)	6	150	
Panel Operators 4)+5)	22	100	
Field Operators 3)	28	100	
Subtotal	5.9	US\$/T-NH3	
Maintenance Cost ②	18.5	US\$/T-NH3	CAPEX x 1.5%
General & Administrative Expenses (Plant)	8.4	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	42.4	US\$/T-NH3	
<b>2. Variable Cost</b>			
Natural gas (NG)	107.2	US\$/T-NH3	
Electric Power (Purchase)	9.5	US\$/T-NH3	0.07 US\$/kWh
Industrial Water (Purchase)	6.4	US\$/T-NH3	0.60 US\$/WT-t
Catalyst and Chemicals	6.1	US\$/T-NH3	
CO2 Transfer	39.7	US\$/T-NH3	30.0 US\$/t-CO2
Total	169.0	US\$/T-NH3	
Cash Cost (1+2)	211.4	US\$/T-NH3	

Export Price (FOB)	341.0	US\$/T-NH3	
Freight	72.0	US\$/T-NH3	FOB, Fuel Tanker
CIF Price in Japan	413.0	US\$/T-NH3	

	EIRR = 9.0%					Average of 20 Years
	1st Year	8th Year	13th Year	18th Year	20th Year	
Construction and Commissioning: 4 years						
The duration of the project is assumed to be 20 years.						
Fixed Cost (US\$/t-NH3)	42.4	42.4	42.4	42.4	42.4	42.8
Labor Cost	5.9	5.9	5.9	5.9	5.9	6.0
Maintenance Cost	18.5	18.5	18.5	18.5	18.5	18.5
General Management Cost, Insurance, Tax, and Rent	18.1	18.1	18.1	18.1	18.1	18.3
Variable cost (US\$/t-NH3)	169.0	169.0	169.0	169.0	169.0	169.0
Cost of Natural Gas	107.2	107.2	107.2	107.2	107.2	107.2
Cost of CO2 Sequestration	39.7	39.7	39.7	39.7	39.7	39.7
Others	22.1	22.1	22.1	22.1	22.1	22.1
Depreciation & Interest (US\$/t-NH3)	113.5	100.8	91.7	0.0	0.0	75.6
Depreciation Expenses	86.2	86.2	86.2	0.0	0.0	64.7
Interest	27.3	14.6	5.5	0.0	0.0	10.9
Corporate Tax (US\$/t-NH3) *	3.2	5.8	7.6	25.9	25.9	10.8
Profit (after Tax)	12.8	23.0	30.3	103.7	103.7	42.8
(Equity share of depreciation added)	38.7	48.9	56.2	103.7	103.7	62.2
Export Price (FOB) (US\$/t-NH3)	341.0	341.0	341.0	341.0	341.0	341.0
Transportation (Freight)	72.0	72.0	72.0	72.0	72.0	72.0
CIF Price in Japan (US\$/t-NH3)	413.0	413.0	413.0	413.0	413.0	413.0

Note \*: Corporate tax is estimated based on the profit on accounting basis, not on net cash flow basis.

(Financial Condition)					
Interest Rate	3.0%	-			
Annual Rate of Price Increase (NH3)	0.0%	-			
Annual Rate of Price Increase (NG)	0.0%	-			
Annual Rate of Price Increase (Others)	0.0%	-			
D/E (Equity%)	30%	-			
Corporate Tax	20%	-			

Cost Breakdown by Segment (First Year)	
US\$/T-NH3	
1 Purchase of Natural Gas	107.2
2 NH3 Production , CO2 Capture, etc.	194.1
3 CO2 Sequestration	39.7
4 Export Price (FOB)	341.0
Transportation from Country of Production to Japan	72.0
CIF Price in Japan	413.0
Yen/T-NH3	
5 Unloading and Delivery	0.0
In-tank Price (User's Price)	44,191

Exchange Rate 107 Yen/US\$

= Default Input (Recommended V)  
 = Input for Sensitivity Analysis  
 = Input for IRR sheet