

Prospects of Green Ammonia in Fertilizer Industry



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Introduction

- Ammonia is second most produced chemical worldwide.
- World ammonia production was 183 million MT in 2020.
- Projected is expected to 223 million MT by 2030 and 330 million MT by 2050.
- About 85% of ammonia is used to manufacture fertilizers.

Introduction

- Around 90% of ammonia is consumed at site as feedstock.
- About 30 million tonne ammonia is transported by road, rail, pipeline and ship.

Introduction

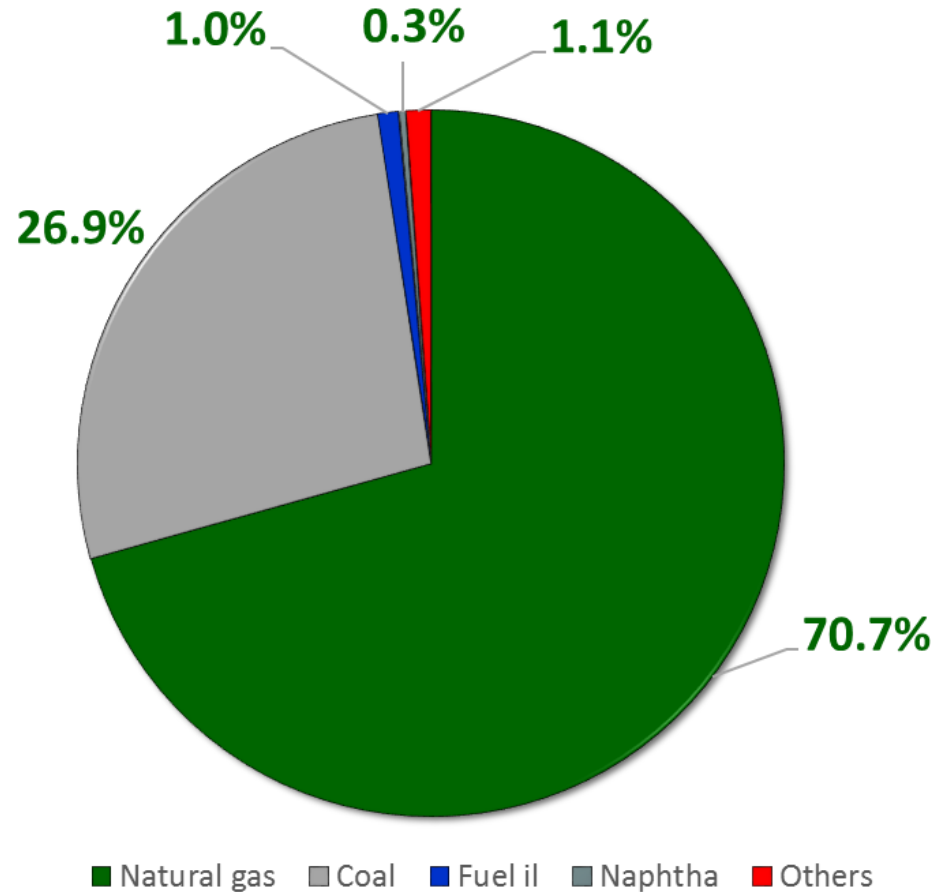
- Use of fossil fuels to manufacture ammonia accounts for 1% of total GHG emissions.
- Indian ammonia plants generate less than 2.0 MT CO₂ per MT ammonia.
- Most Indian ammonia production is used to produce urea. An average of 1.3 MT CO₂ per MT ammonia is converted to urea.

Production, Import and Consumption of Fertilizers (2021-22)

Fertilizer	Production	Imports	Consumption
Urea	25.08	9.14	34.18
Single Super Phosphate	5.35	NIL	5.68
DAP	4.22	5.46	9.27
Other Complex Fertilizers	8.31	1.17	11.48
Muriate of Potash (MoP)	NIL	2.46	2.46 (direct application balance is used in production of complex fertilizers)
Other Straight Fertilisers (AS, ACI, SOP)	0.79	0.18	0.84
Total Products	43.75	18.40	63.91

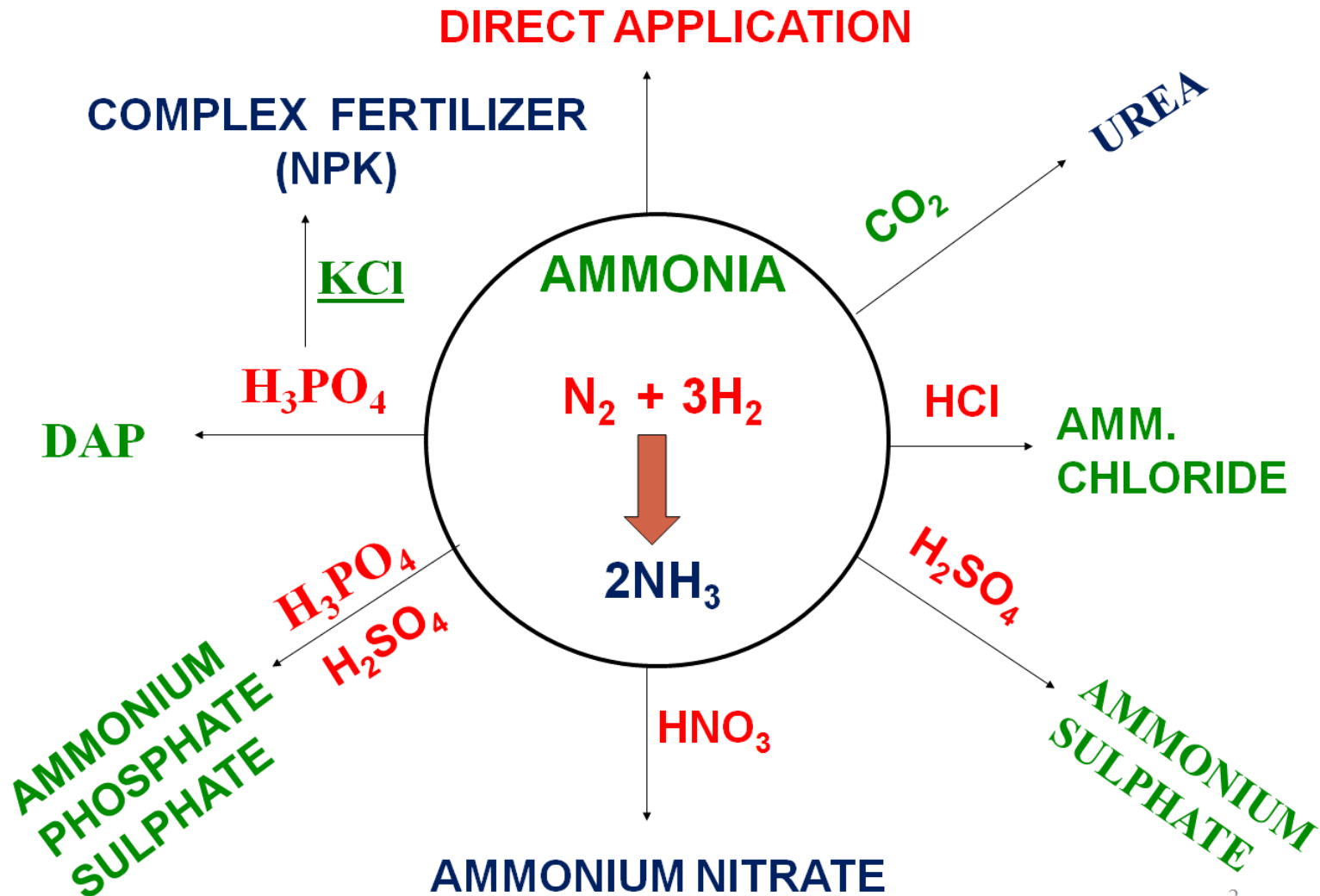
Feedstock wise Ammonia Capacity, 2020

Feedstock	Capacity (million tonnes)
Natural Gas	156.1
Coal	59.5
Fuel Oil	2.1
Naphtha	0.7
Others	2.5
Total	220.8



Source: IFA

Ammonia is the building block of all nitrogen containing fertilizers



Production and Use of Ammonia in India 2021-22

Sl. No.	Sources of Ammonia	Million Metric Tonnes
1.	Domestic Ammonia Production	15.7
2.	Imported Ammonia	2.3
3.	Ammonia in imported DAP, NP/NPK and Urea	9.3
4.	Total Ammonia Utilized	27.3

Production and Use of Ammonia in India

- Ammonia production is expected to go upto 19 million tonnes in 2023-24
- About 95% of domestic ammonia will continue to be used to manufacture urea
- All the imported ammonia is used to manufacture complex fertilizers

Other Uses of Ammonia

- Nitric Acid – Ammonia Nitrate – Explosives
- Refrigeration
- Chemical, Pharmaceutical and other industries
- NO_x abatement
- Other Potential Uses
 - Marine Fuel
 - Fuel for Power Generation
 - Carrier of Hydrogen

Natural Gas as Feedstock

- Almost 100% ammonia is produced in India using natural gas
- About 85% gas requirement is met by imported gas (LNG)

First Ammonia Plant based on Electrolysis

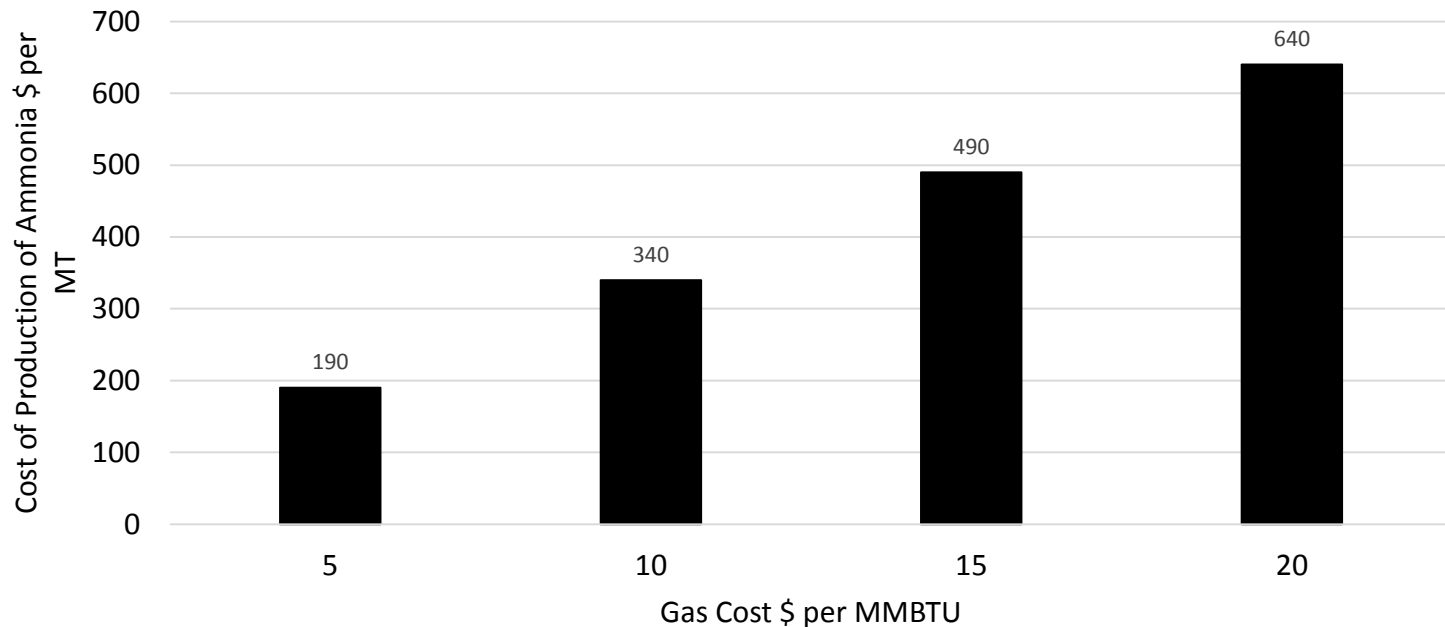
- India Operated an ammonia plant using green hydrogen at Nangal, Punjab between 1961 to 1989.
- Hydrogen was generated by electrolysis using Hydro power.

Storage and Transportation of Ammonia

- Ammonia is hazardous chemical and toxic under ambient conditions.
- It is stored as liquid at -33°C and atmospheric pressure.
- Ammonia is handled, stored and transported for more than 100 years.
- Risks associated with ammonia storage and handling are managed well with only few incidents.

Cost of Conventional Ammonia

- Cost of production in Indian plants may vary approximately Rs. 20,000 to 30,000 per MT with the gas price.



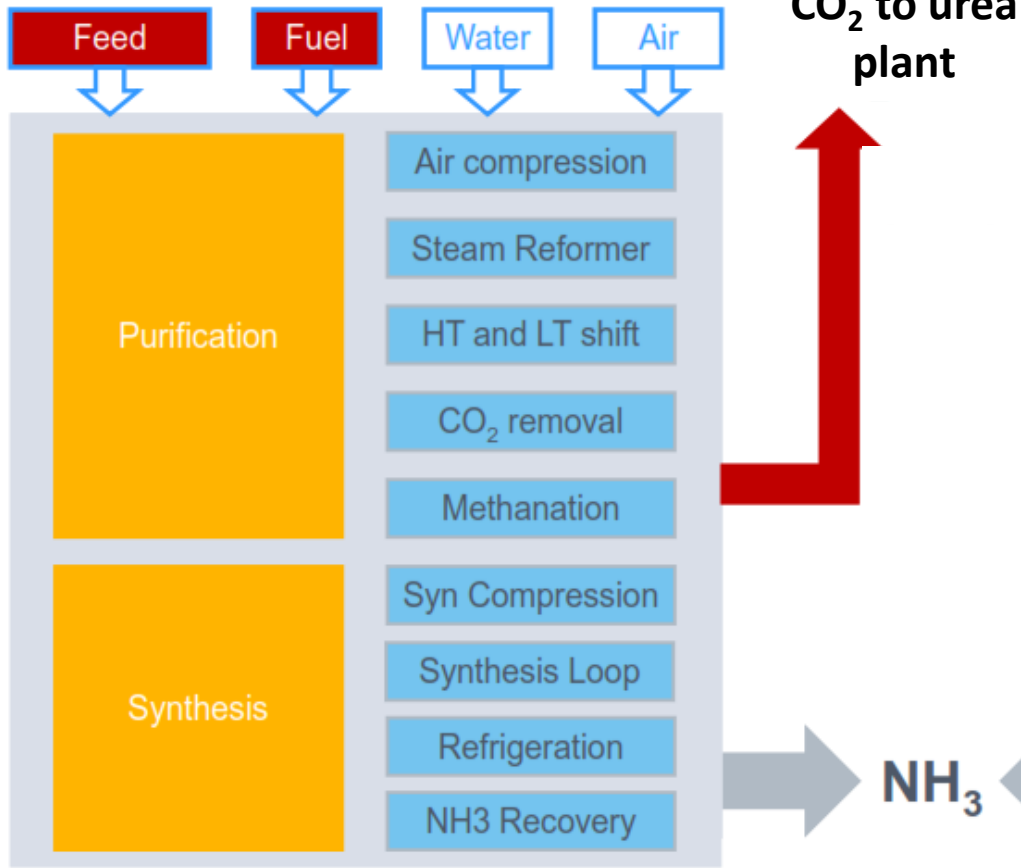
Assumption : Typical energy consumption of 30 million BTU per MT ammonia

Production of Green Ammonia

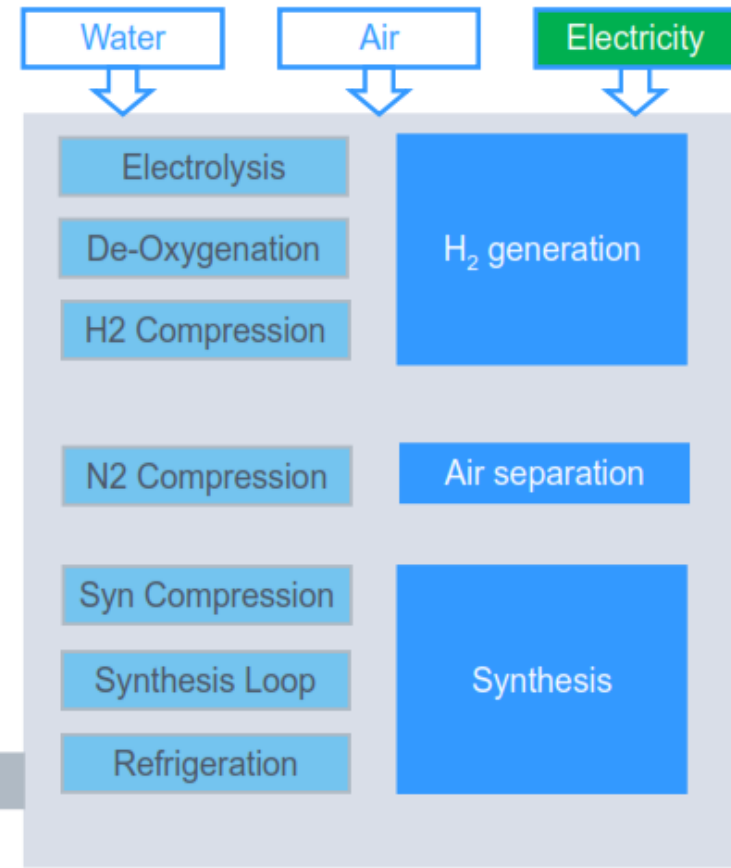
- Three major steps
 - Generation of H_2 by electrolysis of water using renewable power.
 - Air separation to produce N_2 using renewable power.
 - Synthesis of ammonia using renewable power.

Convention V/s Green Ammonia Production

Conventional ammonia production



Electricity-based ammonia production



Use of Green Ammonia in Fertilizer Production

- Production of urea requires carbon dioxide which is a co-product of conventional ammonia production process.
- Green ammonia can be used to produce non-urea fertilizers.
- Existing complex fertilizer plant can utilize 3 – 3.5 million tonnes per year.
- Green ammonia can also be used to products like ammonium sulphate and ammonium chloride.
- There is total requirement of 0.6 million tonnes of hydrogen right away.

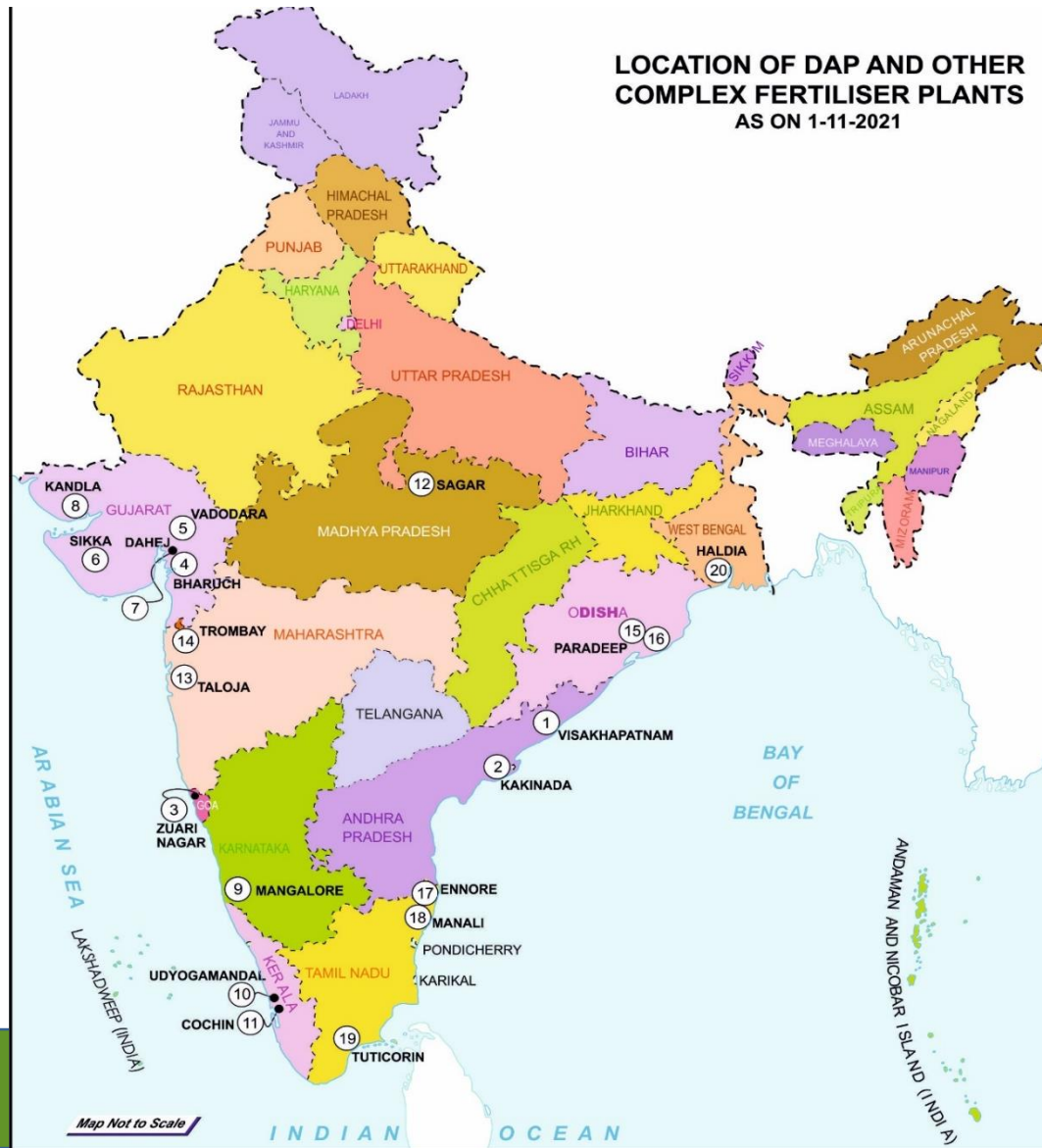
Implications for Cost of Fertilizers

- Use of green ammonia for production of DAP will increase its cost of production.
- Either subsidy retail price for farmers will have to be increased.
- Cost of production of green ammonia is expected to come down in next 5-7 years making it economically viable option for production of non-urea fertilizers.

Location of Green Ammonia Plants

Option 1 : Proximity to complex fertilizer plants (20 locations)

Sl. No	Locations
1	Kandla, Gujarat
2	Sikka, Gujarat
3	Dahej, Gujarat
4	Vadodara, Gujarat
5	Bharuch, Gujarat
6	Trombay, Maharashtra
7	Taloja, Maharashtra
8	Goa
9	Mangalore, Karnataka
10	Udyogmandal, Kerala
11	Cochin, Kerala
12	Tuticorin, T.N.
13	Manali, T.N.
14	Ennore, T.N.
15	Kakinada, A.P.
16	Vizag, A.P.
17 & 18	Pradeep, Odisha
19	Haldia, W.B.
20	Sagar, M.P.



Location of Green Ammonia Plants

Option 2 : Proximity to green hydrogen generation source

Option 3 : Proximity to other ammonia users

Actual location of a green ammonia plant will depend on availability of renewable power, cost of transmission of electricity, cost of storage and transportation of hydrogen and ammonia, etc.

Way Forward

- Commercial plants for production of green hydrogen based on different electrolysis technologies.
- Construction of small of Green Ammonia plants.
- Viability gap funding or R&D funding by the government.
- Replacement of grey ammonia with green ammonia used to manufacture of products other than urea.

Thank You