TRANSFORMING AMMONIA PRODUCTION FOR THE FUTURE

REFUEL Project: Small Scale Ammonia Synthesis Using Stranded Wind Energy
1562-1584

EMPLOY ABSORPTION OF AMMONIA TO REDUCE REACTION PRESSURE, ENERGY CONSUMPTION, AND CAPITAL COST

Example Absorbent - Based on Magnesium Chloride

\[ \text{MgCl}_2 + 6\text{NH}_3 \rightarrow \text{MgCl}_2 \]

1.07 NH\(_3\) to 1 MgCl\(_2\) g/g ratio @ 8.0 atm and room temperature

LOWER ENERGY CONSUMPTION COSTS BY REPLACING THE CONDENSER WITH AN ABSORPTION UNIT

STORE ENERGY AS AMMONIA

Use stranded wind energy to store ammonia...
Annual Average Wind Speed at 80 m

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Annual Average Wind Speed at 80 m

...or fertilizer...

Acres of Corn Harvested for Grain as Percent of Harvested Cropland Acreage: 2012

...as energy for the farm...

Wind resource estimates developed by AWS Truepower LLC for windNavigator
https://windexchange.energy.gov/maps-data/191/

WIND SPEED IN M/S

< 4.0

4.0

5.5

5.0

6.0

6.5

7.0

7.5

8.0

8.5

9.0

9.5

10.0

10.5

>10.5

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...as energy for the farm...

FARM ELECTRICITY

NITROGEN

FERTILIZER

TRUCK FUEL

GRAIN DRYER

TRACTOR FUEL

IRRIGATION GENERATORS

BACKUP GENERATOR

...and as energy for the electrical grid

U.S. Department of Agriculture, National Agricultural Statistics Service
https://www.agcensus.usda.gov/Publications/2012/Online_Resources/Ag_Atlas_Maps/Crops_and_Plants/Field_Crops_Harvested/12-M161-RGBChor-largetext.pdf

STRANDED ENERGY POWERS AMMONIA PLANT

How energy from stranded wind powers ammonia plant: https://energy.gov/articles/arpa-e-project-takes-innovative-approach-electrical-grid

STRANDED ENERGY POWERS AMMONIA PLANT

Generator Converts Ammonia to Electricity

NATIONAL RENEWABLE ENERGY LABORATORY

UNIVERSITY OF MINNESOTA

PROTON

A net company