



Green Ammonia-Fueled Power Production

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Ammonia has many uses as a fuel

Industrial Heating

- Blended with fossil fuels like natural gas
- Boilers, grain drying, fuel refining



Transportation

- Off-highway applications
- Agriculture, marine, rail, and mining

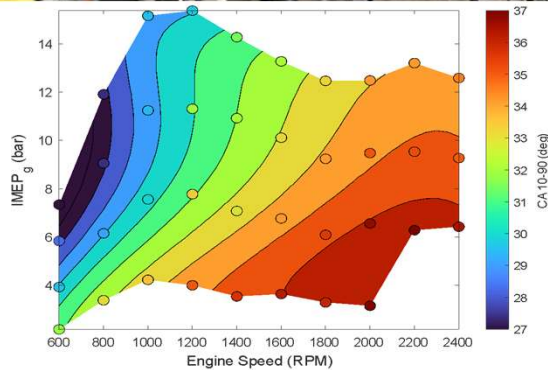
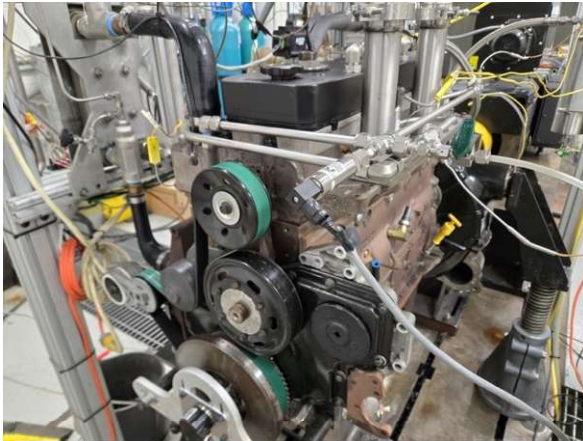
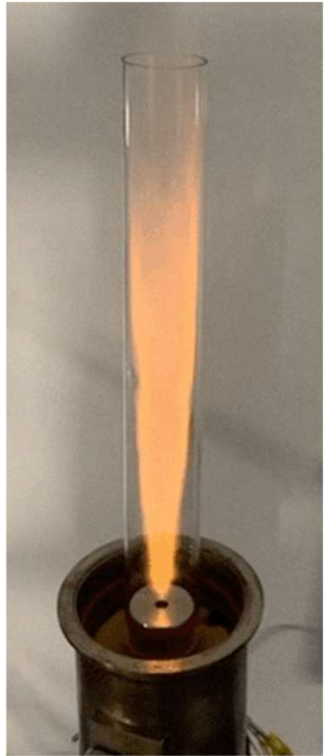


Power Generation

- Burned directly or blended
- Range of power output
- Reciprocating engines and turbines



Research and Development is needed to advance the state-of-the-art and maintain Minnesota's dominance



Advantages:

- Higher energy content compared to H_2
- Existing infrastructure
- No particulate or carbon emissions

Accomplishments:

- First to demonstrate low emissions diesel/ammonia dual fuel
- Proprietary ammonia burner technology
- Full range reciprocating engine operation with 100% ammonia

Remaining Challenges:

- Material compatibility and fuel handling
- Unburned ammonia emissions
- Nitrogen oxides emissions (NO_x , N_2O)

Demonstration of research results needed to advance the state-of-the-art and maintain Minnesota's dominance

2013

UMN WCROC ammonia production



2019

50/50 ammonia/diesel dual fuel tractor



2022

240 kW ammonia grain dryer



2025

200 kW 100% ammonia genset



2026 and beyond

2+ MW gas turbine and engine



Minnesota will host the 4th International Ammonia Energy Symposium in September 2025



4th Symposium on Ammonia Energy
Minneapolis, MN
Sept. 27th - Oct. 2nd

<https://soae.umn.edu/>