

## **FuelPositive's Green Ammonia Production System**

FuelPositive's green ammonia production system takes air, water and a sustainable electricity source to produce green anhydrous ammonia.

The system comprises a nitrogen generator to produce nitrogen from air, a water electrolyzer to produce hydrogen from water, and a novel green ammonia synthesis reactor to produce ammonia from the hydrogen and nitrogen. Our provisional patent is for the green ammonia synthesis reactor technology.

## Produced where you need it – In situ



- Our green ammonia can be produced where it is needed.
  - The production of green ammonia using Fuel-Positive's unique production system is scalable
    It can be produced for both small- and largescale applications.
- As long as there is a sustainable source of electricity, a FuelPositive green ammonia production system

can produce green ammonia around the clock at any location, providing fuel for ammonia-burning generators to meet virtually any energy requirement.

- By building transportable systems using shipping container configurations, FuelPositive's production systems can be set up on site:
  - Small stand-alone systems for transportation companies or small farms
  - Larger agricultural systems for significant farming enterprises
  - Large grid storage systems for the biggest wind, solar or geothermal electricity generation operations
- FuelPositive is working with National Compressed Air Canada to build its first full-scale commercial prototype systems.
  - The production units are being built for easy transport and deployment (e.g., 20-foot and 40-foot shipping container platforms).
  - Initial units will produce up to 300 kilograms of green ammonia per day.
- Pilot projects in the agriculture sector are planned to be rolled out throughout 2022.

Farms will produce their own fuel for their vehicles and machinery – and they will produce their own ammonia fertilizer to safely store and carry essential nitrogen into the soil.



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## **Costing Model**

For the purposes of this costing model, FuelPositive has worked from a case study based on a 1,800-acre farm in Manitoba, Canada, where the average price of grey ammonia in 2021 has been calculated at CA\$900 per tonne. (The delivered cost of grey anhydrous ammonia to farmers in Manitoba, Canada doubled from CA\$600 to over CA\$1,200 per metric tonne in a period of six months in 2021! That averages at CA\$900 per metric tonne delivered to the farm.)

The initial FuelPositive systems will produce up to 300 kilos (500 litres) of green anhydrous ammonia per day, which amounts to roughly 100 tonnes per year. This output is suitable for our model farm of 1,800 acres. Larger farms would simply add sufficient production capacity to meet their needs – easily done since FuelPositive's green ammonia production units are modular, scalable and portable for precisely this purpose.

The cost of production (operating expenditure or OPEX) for the case study has been calculated by FuelPositive at approximately CA\$560 per metric tonne (based on a hydrogen production efficiency rate of 65%), compared to the current average cost of CA\$900 per metric tonne of grey ammonia. FuelPositive is forecasting under CA\$500 per metric tonne for future systems as production efficiencies improve. Electricity costs for the farm are estimated at CA\$0.045 (4.5 cents) per kilowatt hour. This is based on the current cost of electricity paid in Manitoba, which has a carbon-free, sustainable electricity grid. The electricity cost represents the largest component of the overall cost of the green ammonia produced in the FuelPositive system.

This cost does not take into account any additional potential cost reductions related to carbon credits, which could reduce the cost by 50% or more, or the farmer's own capacity to generate sustainable electricity for the FuelPositive system through solar or wind generation on site. Today the cost of solar power is at parity with the Manitoba grid, however the cost of renewables are predicted to continue to decline.



Solar electricity costs continues to be reduced 11.5% per year as it's been for the last 50 years. Energy efficiency improvement of over 18% by 2026 and a further 9% by 2030. 4% annual increase in natural gas made grey ammonia.

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