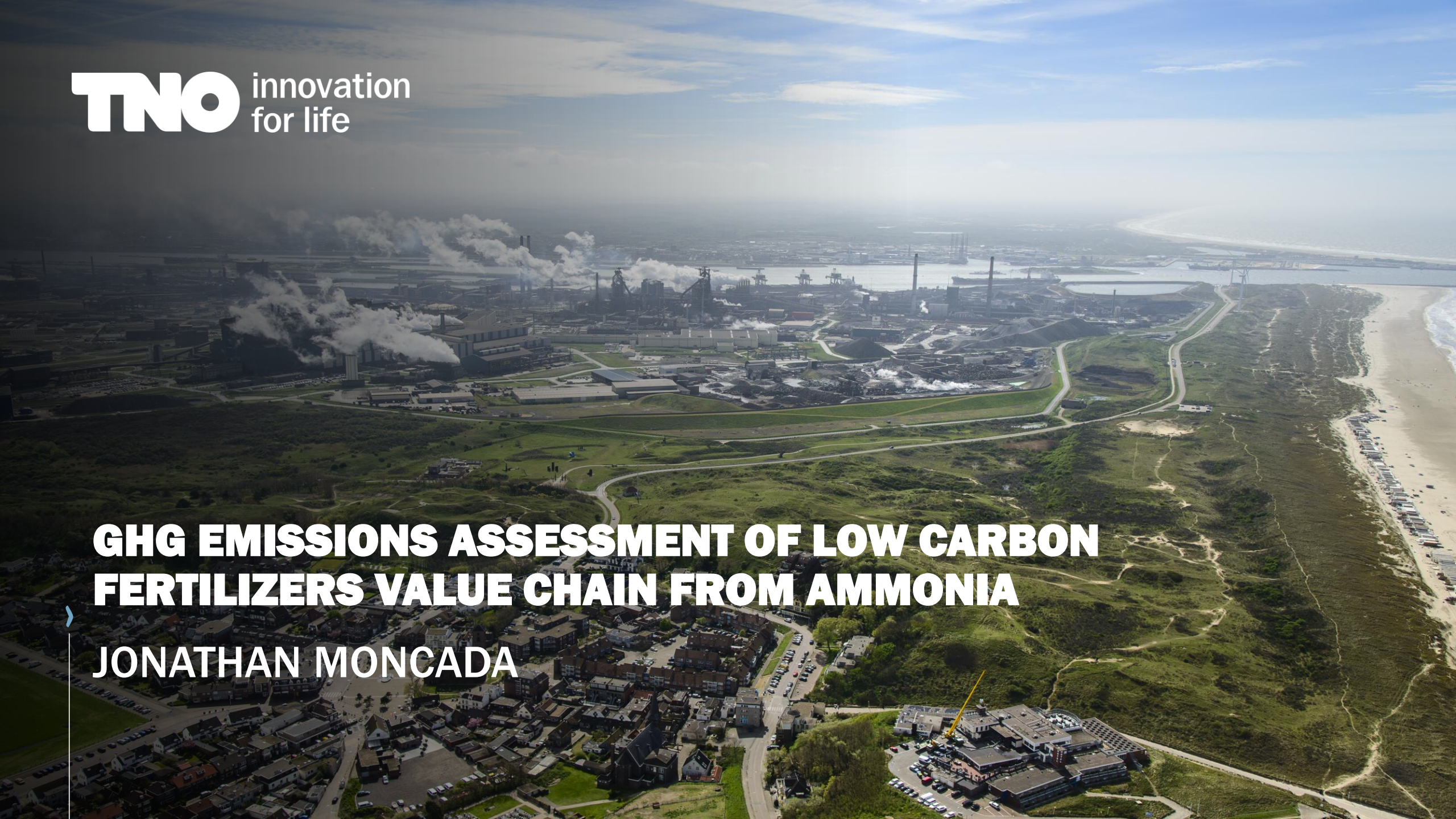


GHG EMISSIONS ASSESSMENT OF LOW CARBON FERTILIZERS VALUE CHAIN FROM AMMONIA

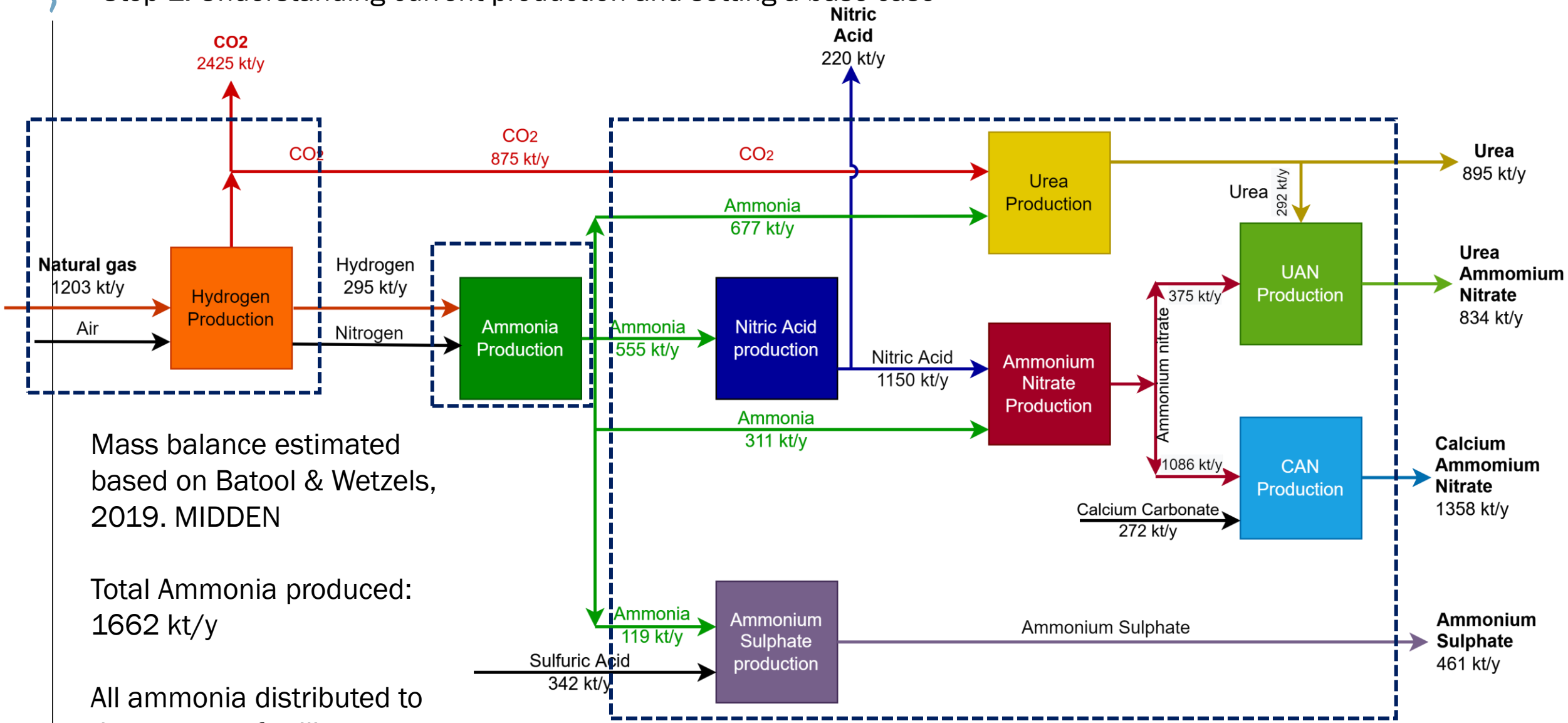
JONATHAN MONCADA

INTRODUCTION AND OBJECTIVE

- The heavy industry of the Netherlands aims to decarbone for 2050
- One important industry is the fertilizer industry. Two large producers in two different industrial clusters
- Currently both use natural gas as hydrogen source for Ammonia production.
- The production of fertilizers is a complex process which involves the production of several intermediates such as Ammonia, Nitric Acid, Ammonium Nitrate, Ammonium Sulphate, among others
- The aim of this work is to assess, from a GHG emissions perspective, scope 3 emissions implications when using renewable hydrogen

OVERVIEW OF LOW CARBON FERTILIZERS

Step 1. Understanding current production and setting a base case



Mass balance estimated based on Batool & Wetzels, 2019. MIDDEN

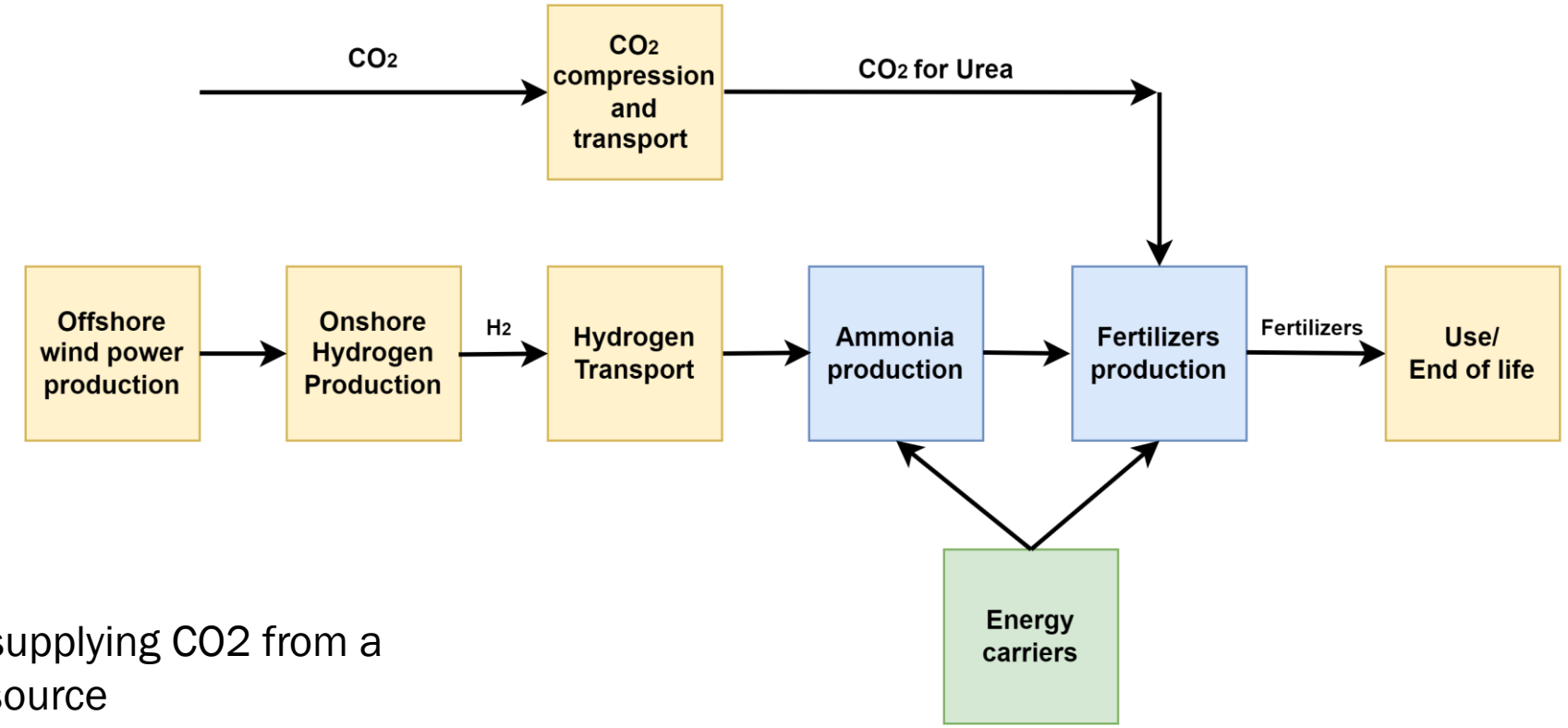
Total Ammonia produced: 1662 kt/y

All ammonia distributed to downstream fertilizers production

OVERVIEW OF LOW CARBON FERTILIZERS

Step 2. Setting alternative value chains

Alternative 1. Producing low carbon ammonia from green hydrogen in the Netherlands



Implications

- Need for supplying CO2 from a different source
- Air separation unit would be required to supply nitrogen to ammonia
- Ammonia and fertilizers produced on site

CO2 supply assessed from two sources

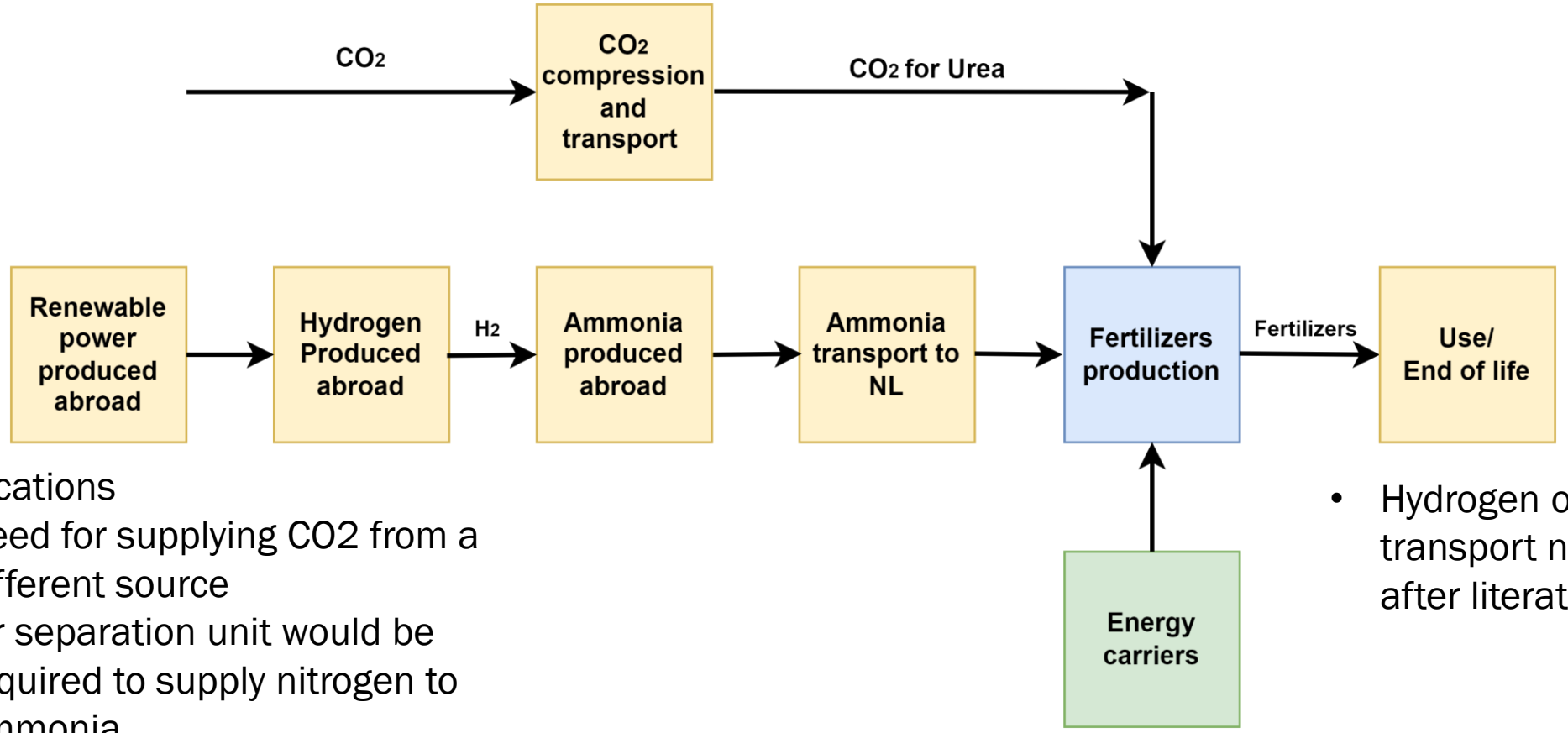
DAC

Point source

OVERVIEW OF LOW CARBON FERTILIZERS

Step 2. Setting alternative value chains

Alternative 2. Producing green ammonia abroad and importing it to the Netherlands



Implications

- Need for supplying CO2 from a different source
- Air separation unit would be required to supply nitrogen to ammonia
- Only fertilizers produced in NL
- Current production plants would exclude ammonia production

- Hydrogen overseas transport not considered after literature review

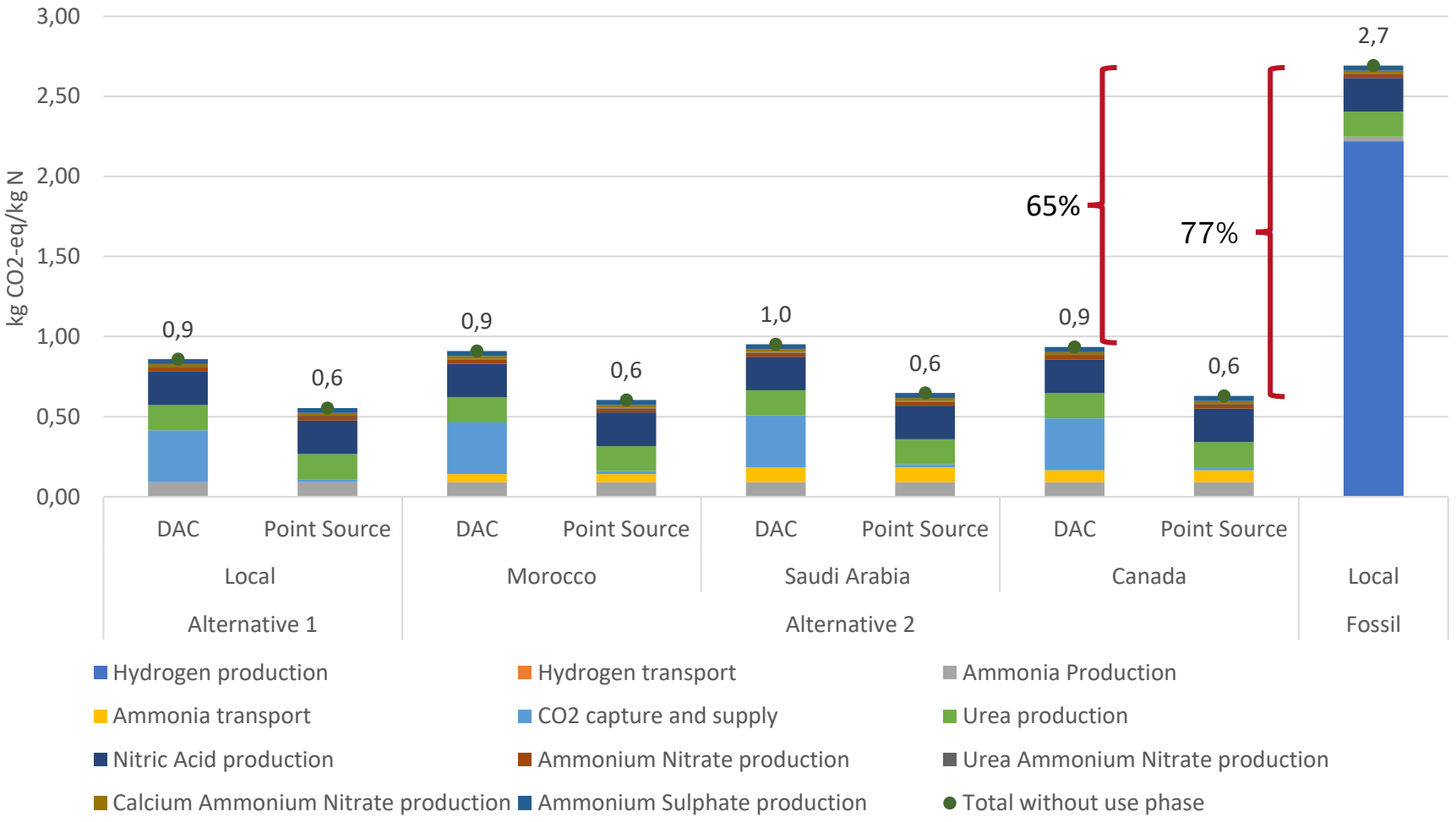
CO2 supply assessed from two sources

DAC

Point source

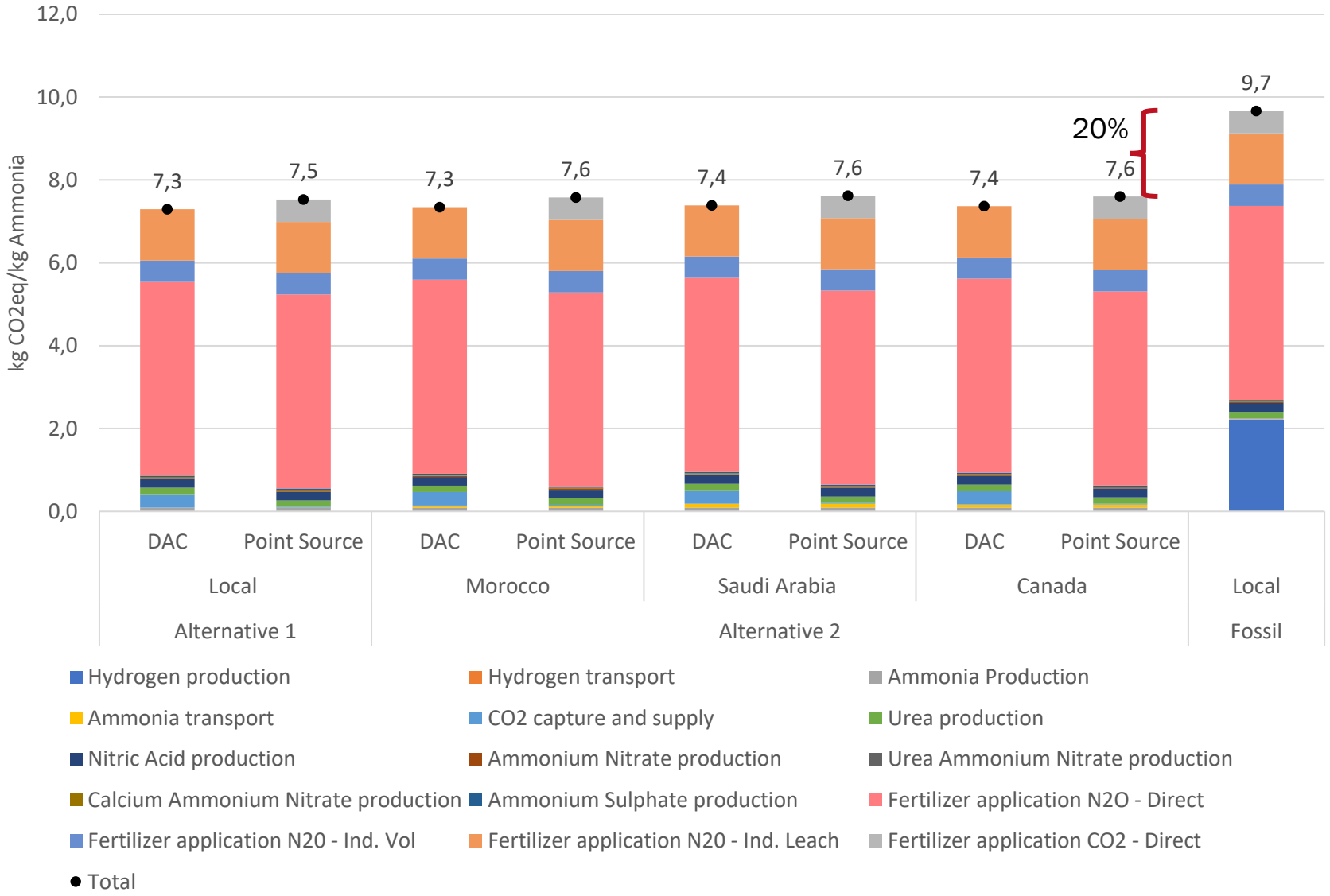
RESULTS

Results Cradle-to-Gate (Use phase not included)



- The main bottle neck in fossil value chain is hydrogen production
- Replacing hydrogen production improves significantly the performance of the system, BUT…
- Special attention should be paid to the supply of CO2 for Urea production
  - At the gate point source seems to perform better but the story is not complete yet
- Main emissions in nitric acid production are due to N_2O emissions.

RESULTS



- N2O emissions from fertilizer used calculated from IPCC guidelines trier 1. Calculations exclude N2O emissions due to management of soil.
- N2O emissions from fertilizer use consider direct and indirect emissions of fertilizer applications to soil.
- Default emission factors were used. Low end and high end factors were used to assess the uncertainty range. (results not presented)

CHALLENGES AND NEXT STEPS

- Fertilizer production requires energy inputs, which are difficult to decarbonize such as heat. Not included in this assessment.
- End of life is tricky to assess as it depends on agricultural practices and how nitrogen is absorbed by soil and agricultural products.
- Bad agricultural practices may end up in releasing a large amount of N2O to atmosphere which highly contributes to GHG emissions.
- An in depth analysis of the use phase is difficult, but results suggest that N2O emissions are highly responsible for a large share (67-90%) of total systems emissions. Thus the question that arises is how to decrease those GHG emissions from fertilizers use?

THANK YOU FOR
YOUR TIME

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