



COPERNIC

# COPERNIC CATALYSTS

**A Drop-in HB Catalyst to Reduce Synloop OpEx by up to 47%**

AEA Annual Conference: Startup Showcase

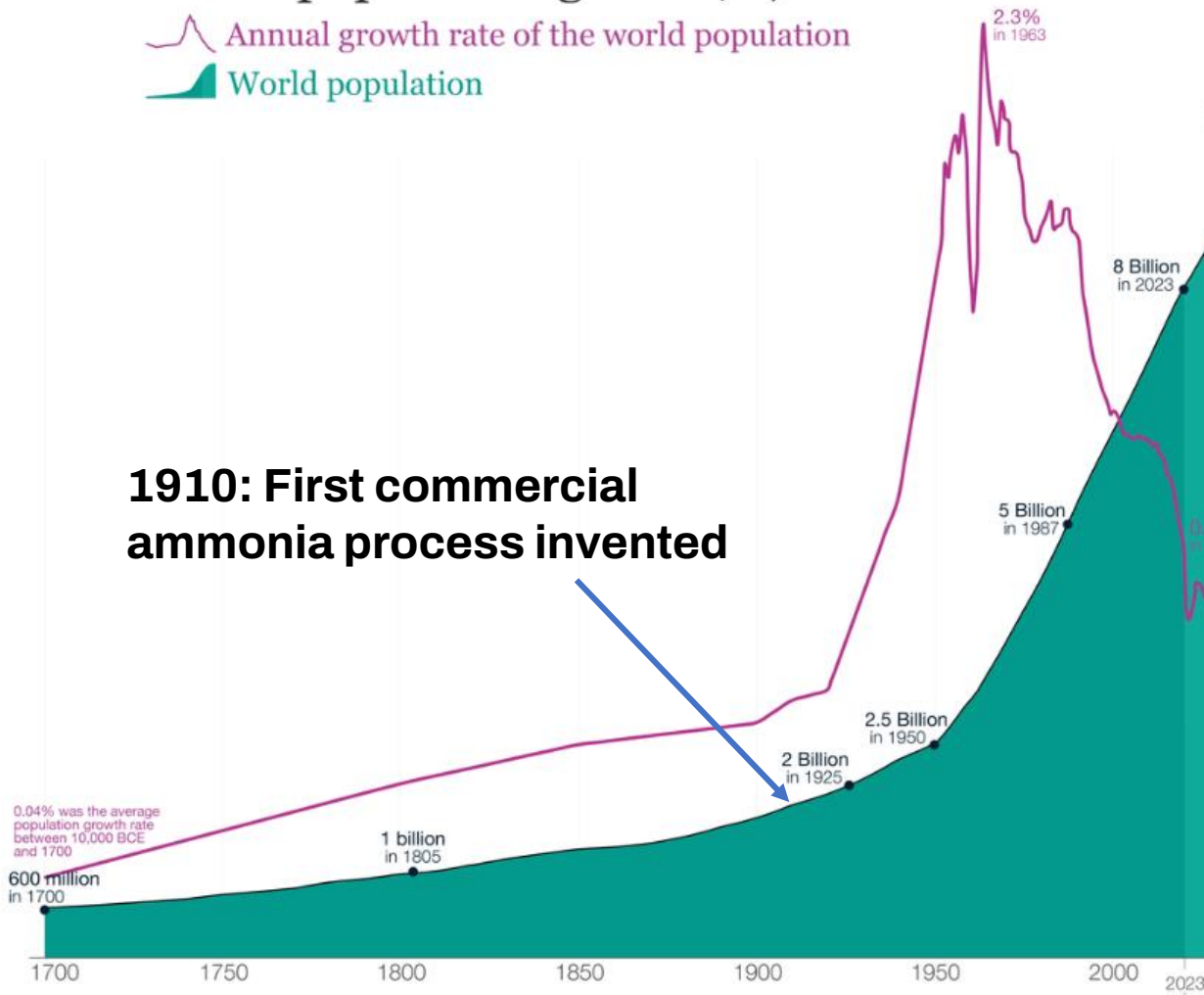
November 13<sup>th</sup>, 2024

# The first ammonia revolution: Agriculture

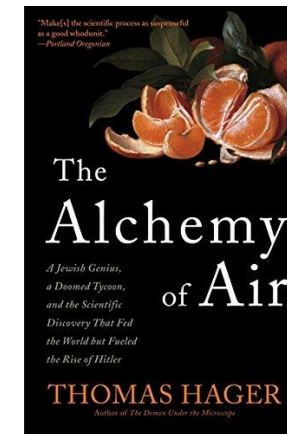
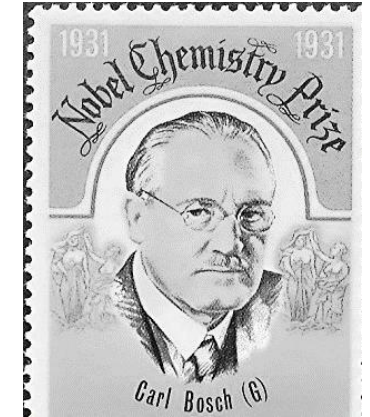
## The most impactful discovery of the 20<sup>th</sup> century

### World population growth, 1700-2100

Annual growth rate of the world population  
World population



Data sources: Our World in Data based on HYDE, UN, and UN Population Division [2022 Revision]  
This is a visualization from [OurWorldinData.org](https://ourworldindata.org), where you find data and research on how the world is changing.



# The catalyst behind the first ammonia revolution



In 1909, a team working under Carl Bosch at BASF performed **20,000 experiments** to develop an ammonia catalyst based on iron oxide.

This century-old material is more-or-less the same catalyst that is used today because it is **made of an abundant metal (iron), is proven, and performs well enough.**



# Why we need better



## AGRICULTURE | CHEMICALS

Ammonia made from fossil fuels causes  
>1% of global CO<sub>2</sub> emissions (~450 Mt/yr)

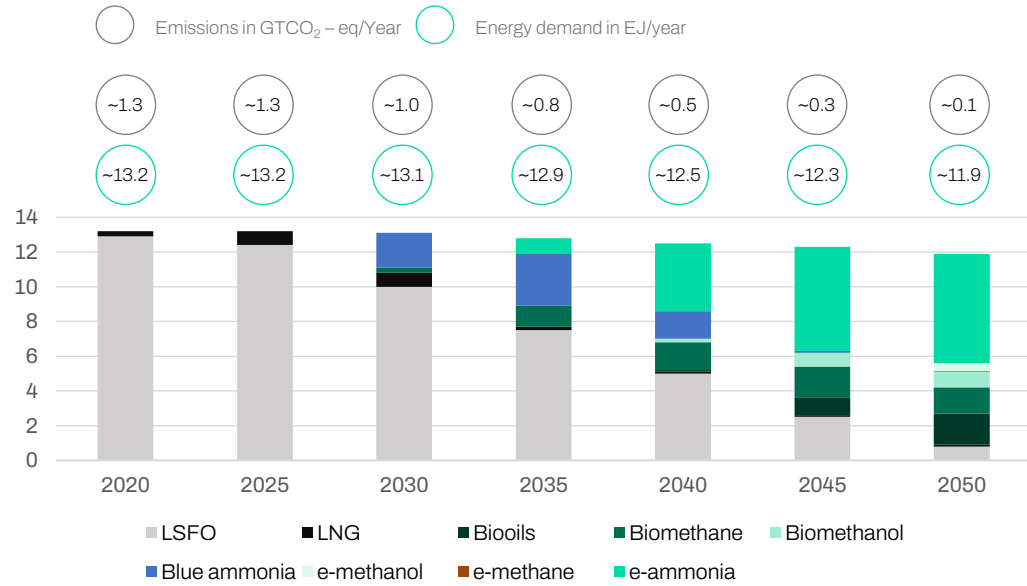


## ENERGY | TRANSPORTATION

Maritime shipping causes  
~3% of global CO<sub>2</sub> emissions (~1000 Mt/yr)



# The second ammonia revolution: Energy

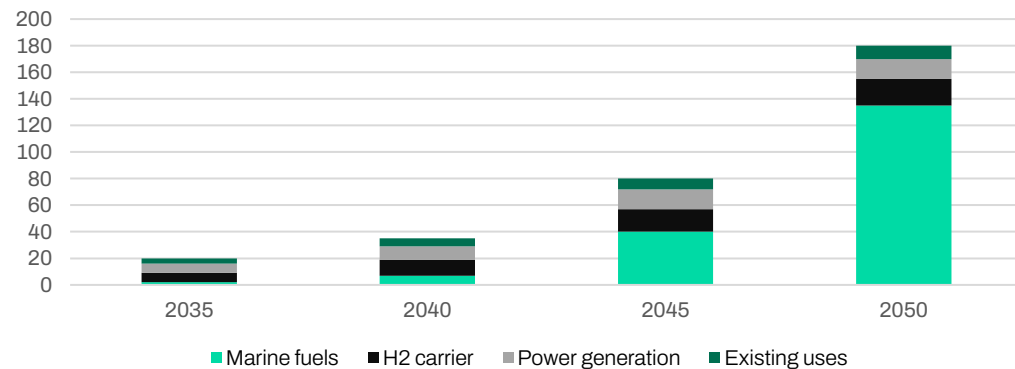


Source: Maersk Mc-Kinney Møller Center for Zero Carbon Shipping



# 50%

of all shipping fuel to be zero-carbon ammonia by 2050



Source: Argus Media



# x2

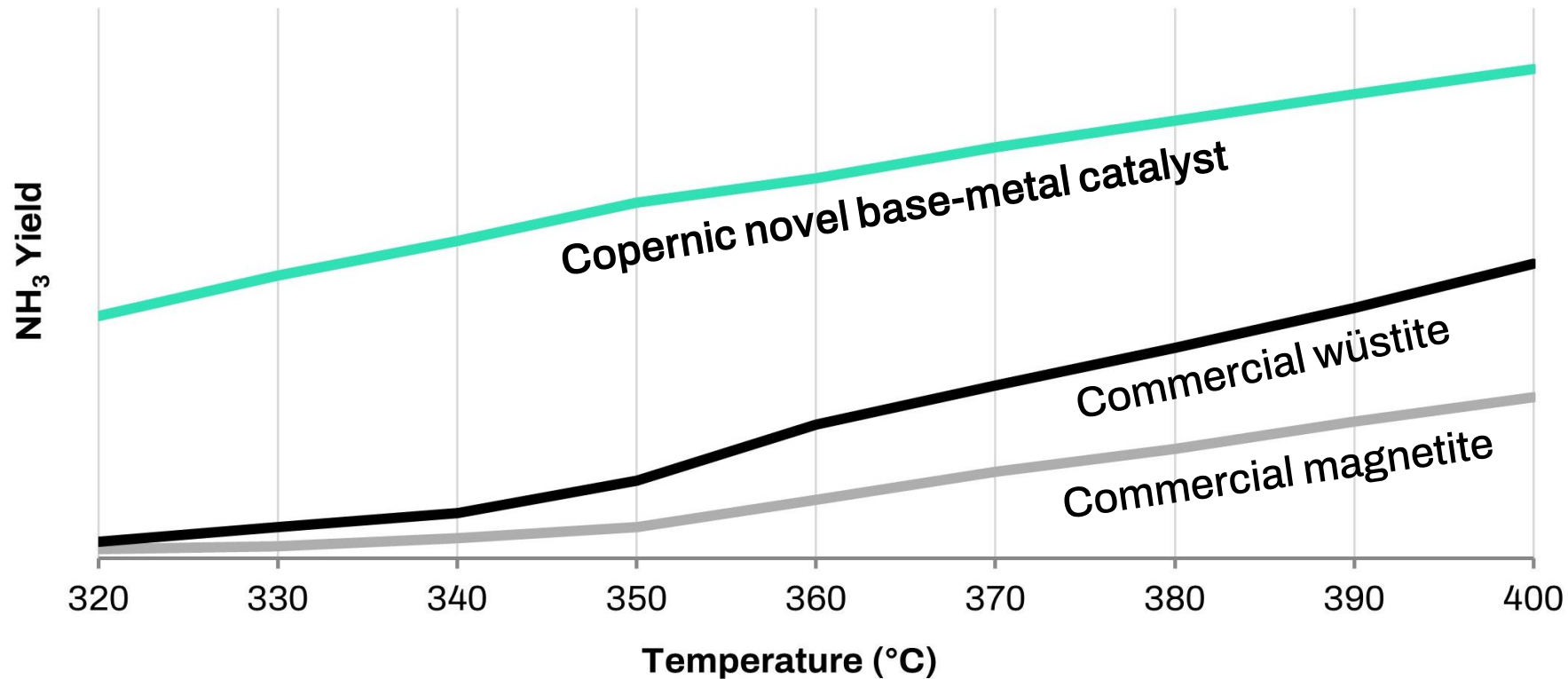
Requires a doubling of the world's ammonia production

**Low- and zero-carbon ammonia must be cheaper**



# Breakthrough base-metal catalyst for all colors of ammonia production

Ammonia Yield vs. Temperature under Mild Operating Conditions



- **Copernic's catalyst strongly outperforms** the best ammonia catalysts on the market
- **100% scalable base-metal formulation** using standard manufacturing techniques
- **Drop-in replacement** for standard Haber-Bosch ammonia catalyst



# Wide range of economic benefits, depending on retrofit/greenfield scenarios

Benefits to syn. loop	Scenario 1A: Simple 'low-CapEx' retrofit to reduce OpEx	Scenario 1B: Simple 'low CapEx retrofit to reduce Opex	Scenario 2: Retrofit/greenfield to significantly increase plant throughput	Scenario 3: Retrofit/greenfield for the lowest possible OpEx
Operating T/P	350-400 °C/No change	Lower RX inlet T only/No change	350-400 °C/No change	350-400 °C/~90 bar
Plant throughput vs baseline (retrofit)	Same as base case	Same as base case	<b>Up to 53% increase</b>	Same as base case
Opex (CO <sub>2</sub> ) per unit NH <sub>3</sub>	Up to 10% decrease	~0-10% decrease (not yet modeled)	Up to 10% decrease	<b>Up to 47% decrease</b>
Capex needed for retrofit	<b>Small (HX only)</b>	<b>Very small (HX only)</b>	Medium (HX plus feed/feed compressor upgrade if no slack)	Medium (HX plus downsize feed/recycle compressors)
Capex per unit NH <sub>3</sub> (greenfield)	Same as base case	Same as base case	Moderately (mid-scale) to <b>significantly lower (large-scale)</b>	<b>Significantly lower</b>
Cost per unit NH <sub>3</sub>	Slightly lower	Slightly lower	Moderately lower	<b>Significantly lower</b>
Engineering feasibility	<b>High</b>	<b>High</b>	<b>High</b>	Moderately high



# Executive team with deep industry experience



**Jacob E. Grose, Ph.D.**  
Co-founder and CEO

- Former Investment Manager, BASF Venture Capital
- 12+ years of business experience in chemicals industry
- Technical background: Ph.D. in physics (Cornell)



**Aruna Ramkrishnan, Ph.D.**  
Co-founder and CTO

- Held technical leadership positions at ExxonMobil and Linde
- Expertise in emissions mitigation technologies, sustainable materials and processes
- Ph.D. in Chemical Engineering (University of Minnesota)



## Current non-executive board members

## Copernic platform designed for industry needs

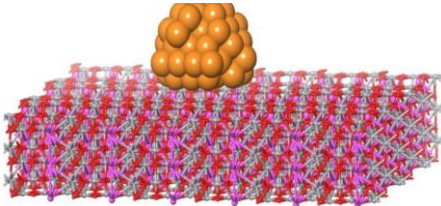


**Mike Kearney**  
• Board Member and Seed Investor, Copernic  
• Partner, The Engine



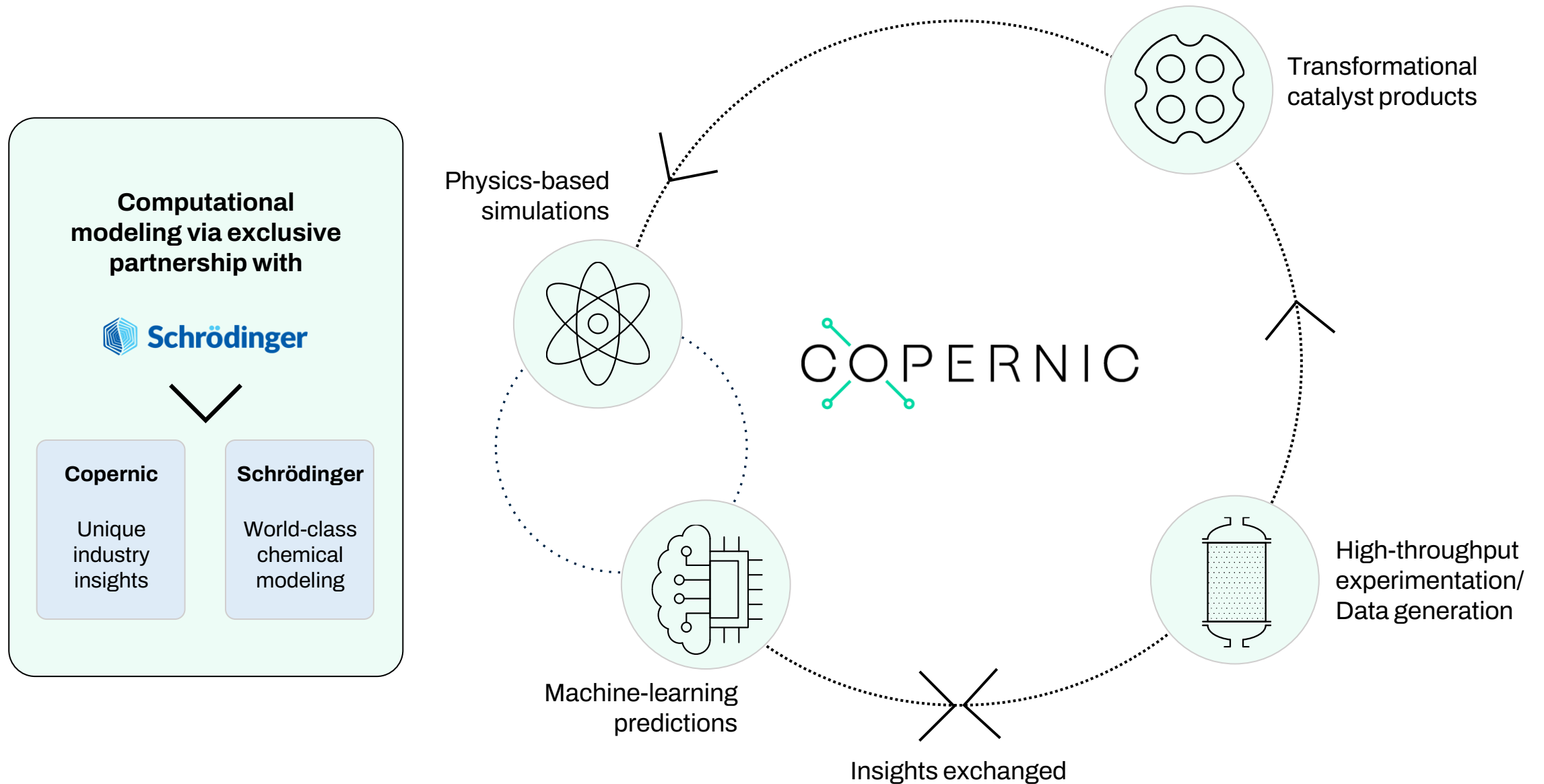
**Michael LoCascio**  
• Independent Board Member, Copernic  
• Global Sustainability Strategy Leader at BASF Environmental Catalysts and Metal Solutions

Focus on designing drop-in, scalable catalyst solutions that solve urgent needs



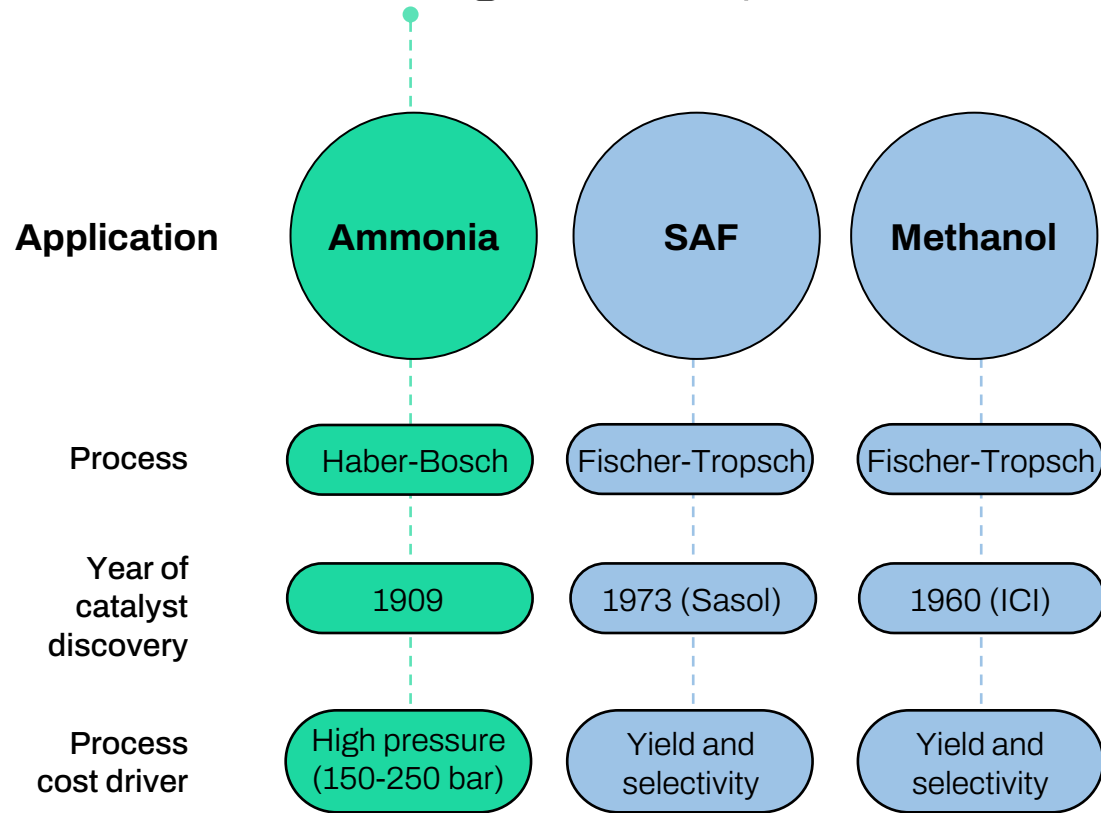


# Copernic's proprietary discovery platform



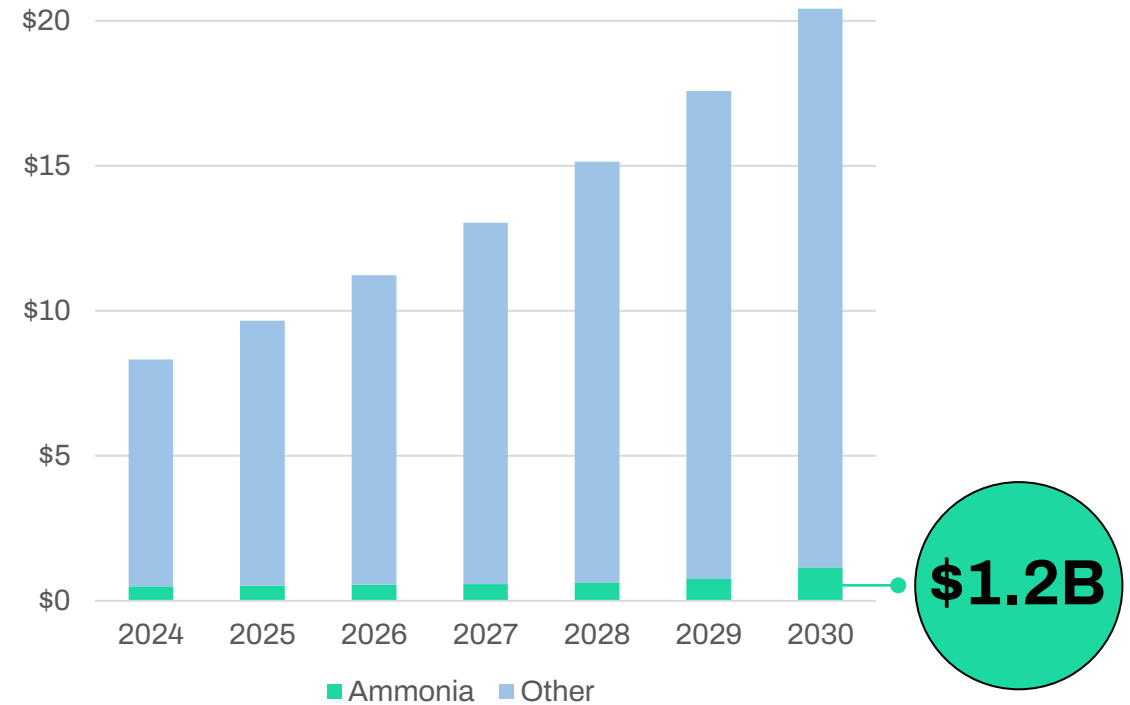
# A platform company selling catalysts critical to decarbonization

**Copernic's** first product is a drop-in solution transforming ammonia production



**Copernic's** portfolio of proprietary catalysts will be the “picks and shovels” of the decarbonization rush

**Target Catalyst Markets (\$B)**



# High-level proposal for a partnering plan

4 years

Jul '24-Dec '24

**Initial discussions**

**Role of customer:**

- Get documentation in place/agree on targets

**Customer inputs:**

- Team support

**Success metric:**

- Partnership agreements in place (LOI, NDA, MTA, Testing agreement)

Jan '25-Jun '26

**Gram-scale powder testing**

**Role of customer:**

- Gram-scale performance testing (optional)

**Customer inputs:**

- Fully-loaded cost of samples (\$1,000)
- Testing costs (internal)

**Success metric:**

- Performance meets pre-agreed technical targets

Jul '26-Dec '27

**Kg-scale granule testing**

**Role of customer:**

- Kg-scale stability testing
- Parallel testing at Copernic

**Customer inputs:**

- Fully-loaded cost of samples (TBD)
- Testing costs (internal)

**Success metric:**

- Performance/stability meet pre-agreed technical targets

Jan '28-Jun '28

**Commercial/ scale-up**

**Role of customer:**

- Testing of first catalyst in a plant

**Customer inputs:**

- Fulfilling terms of commercial contract

**Success metric:**

- Catalyst meets customer needs

unlocks

unlocks

unlocks



The logo consists of the word "COPERNIC" in a clean, black, sans-serif font. To the left of the text is a stylized icon of a network or molecule, featuring a central point with four lines extending outwards to smaller circles, resembling a cross with rounded ends.

# COPERNIC

The background is a composite image. The top half shows a row of white wind turbines on a green hillside under a cloudy sky. The bottom half shows a large concrete dam with water cascading over its spillways, creating a misty spray. In the foreground, there is a large, flat surface covered with a grid of solar panels, with a blue grid pattern overlaid on the image.

**Jacob Grose, CEO/Co-founder**  
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