Bloomenergy®

SOEC: Ammonia Energy Association Discussion

24 January 2023

BLOOM ENERGY AT A GLANCE

BE LISTED NYSE

Global Footprint

Our corporate, manufacturing, and R&D offices serve as strategic global anchors to help organizations around the world reduce carbon emissions, enhance resiliency, and chart a path toward a net-zero carbon future.

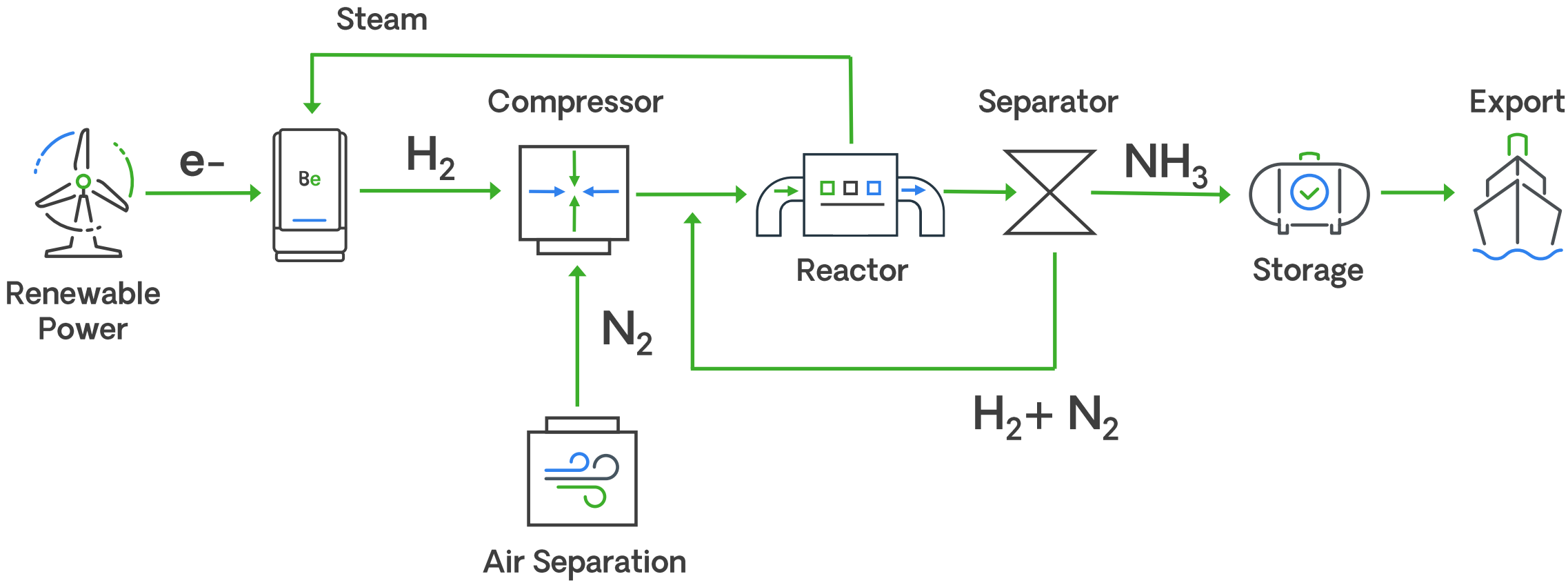
MISSION

To make clean, reliable energy affordable for everyone in the world.

$972mm 2021 Revenue	**30% CAGR** Over last decade	**$8.5bn** Backlog	**12%** Annual Learning Rate (Cost Down)
~1 GW Installed Base (Dec 2022)	**>364** Issued Patents	**>$1.5bn** Cumulative R&D	**48% → 65%** Efficiency Since 1st Generation

Green Ammonia Synthesis

with integrated high temperature electrolysis



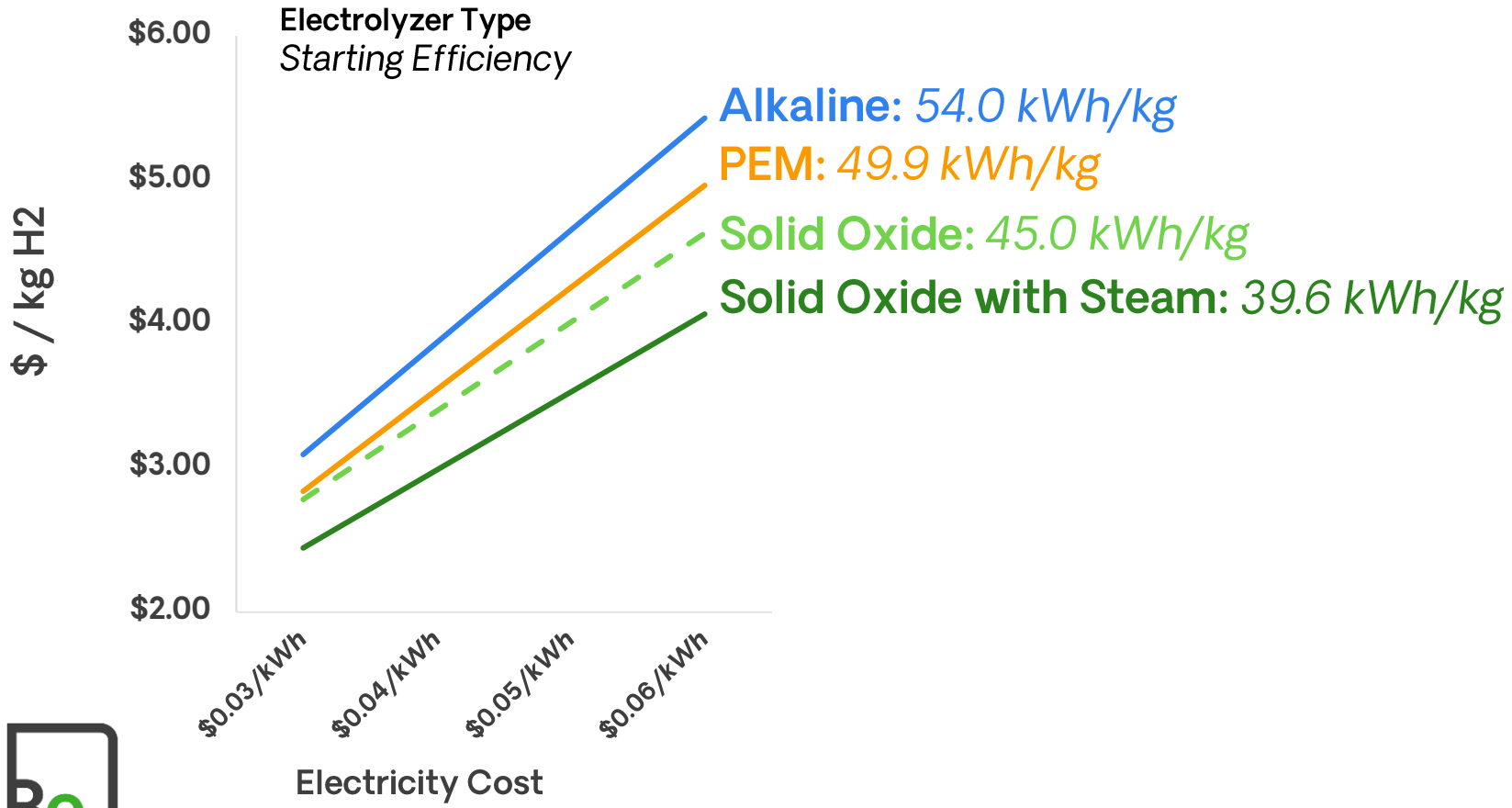
SOEC – SUPERIOR EFFICIENCY

	PEM Electrolysis	Alkaline Electrolysis	Solid Oxide Electrolysis
Description	Based on polymer membrane on a plate under high voltage and high current	Production reaction occurring in liquid alkaline solution	Solid ceramic material as electrolyte operating at high heat to reduce electrical needs
Current product cost ($/kW)	$700-1400[1]	$600-1000[2]	$1100 - $1300
Materials Availability	Limited (PGMs)	High	High (Robust supply chain)
Efficiency (kWh/kg)[3]	52	54	39-45
Estimated learning rate[4]	13%	9%	28%[5]
Supply Chain Readiness	Developing	Mature	Mature

1. Adapted from text of Hydrogen Council, "A Path to Cost Competitiveness." | 2. IRENA, Green hydrogen cost reduction, 2020 | 3. Yates, et. al. "Techno-economic Analysis of Hydrogen Electrolysis from Off-Grid Stand-Alone Photovoltaics Incorporating Uncertainty Analysis | 4. Hydrogen council, "A path to hydrogen competitiveness" | 5. Historical learning rate for Bloom SOFC is 28%

SOEC OFFERS LOWEST-COST HYDROGEN (EXCLUDES PTC)

Levelized Cost of Hydrogen ($/kg)[1]



- **Highest efficiency**
- **Proven performance**
- **Manufacturing platform**
- **Modular approach**

1. Assumptions: Funded by project finance at 8% WACC, 98% capacity factor, 30-year plant lifetime, publicly released cost and technical values, includes impacts of replacement capex and degradation as appropriate.

Idaho National Lab

Location

Idaho Falls, ID

System

Steam Feed

Scope

Operation Period: Indefinite (Q4 '21)

Demonstrate electrolyzer technology to operate continuously with extended system runtime

Peak Performance

Performance	
Hydrogen production	2.76 kg/hr
Hydrogen production	511.51 sL/min
Energy per hydrogen	37.667 kWh/kg
Efficiency (LHV)	88.46%
Efficiency (HHV)	104.63%
Overall utilization	85.43%
Single pass utilization	69.07%
Recycle percentage	61.54%

Standard Performance

Performance	
Hydrogen production	2.685 kg/hr
Hydrogen production	497.649 sL/min
Energy per hydrogen	39.19 kWh/kg
Efficiency (LHV)	85.03%
Efficiency (HHV)	100.56%
Overall utilization	87.51%
Single pass utilization	71.85%
Recycle percentage	63.56%

SOEC OFFERS LOWEST-COST HYDROGEN

Idaho National Lab and Bloom Energy Produce Hydrogen at Record-Setting Efficiencies

Steam combined with high-temperature electrolysis paves way for large-scale hydrogen production in the nuclear industry

SAN JOSE, Calif., Aug. 9, 2022 –Bloom Energy Corporation (NYSE: BE) today announced the initial results of its ongoing demonstration with Idaho National Laboratory (INL), the nation's premier center for nuclear energy research and development. With nearly 500 hours of full load operation completed at the laboratory, Bloom's high-temperature electrolyzer is producing hydrogen more efficiently than other commercially available electrolyzers, including PEM and alkaline.

Researchers at INL have been conducting a variety of tests on Bloom Energy's solid oxide electrolyzer at the Dynamic Energy Testing and Integration Laboratory, including steam and load simulations that replicate nuclear power station conditions, an important step in validating full compatibility with a nuclear facility. Running at high temperatures and high availability, the pilot results reveal the Bloom Electrolyzer is producing hydrogen at 37.7 kWh per kilogram of hydrogen and with 88.5 percent LHV (Lower Heating Value) to DC. Dynamic testing has also been conducted and included ramping the system from 100 percent of rated power to 5 percent in less than 10 minutes without adverse system impacts.

Video - https://www.youtube.com/watch?v=NmnnkVwaaF0

SOEC – HIGH POINTS

- Market leading efficiency – with Electricity as ~75% of electrolysis H2 cost, results in lowest cost and lowest carbon footprint hydrogen
- Ideal solution for ammonia synthesis: waste heat supercharges efficiency
- Stack life – 5+ year life with zero degradation in capacity or efficiency
- Supply Chain: Bloom's manufacturing is in place (Since May 2022) to serve GW scale market; no PGMs
- Resiliency – inherent in design – can change out modules (swappable design) and not take long outages – Electrolyzer availability > 99%
- Operating flexibility – full rates to 5% capacity in minutes, well suited to renewable power feeds
- Traditional Capital Sale model with varying levels of monitoring and support, spare stacks and parts from Delaware

Bloomenergy®

What Powers You

LSB Industries

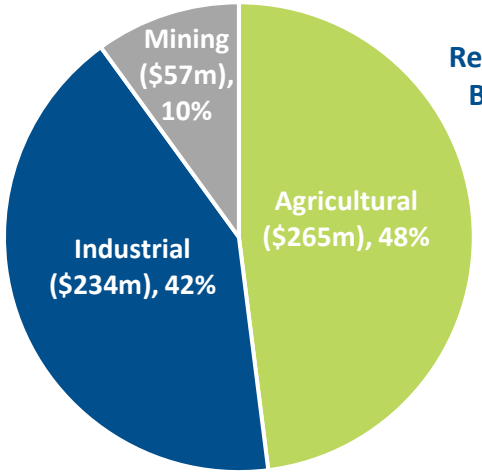
Ammonia production from SOEC Electrolysis

January 24, 2023

LSB Industries at a glance

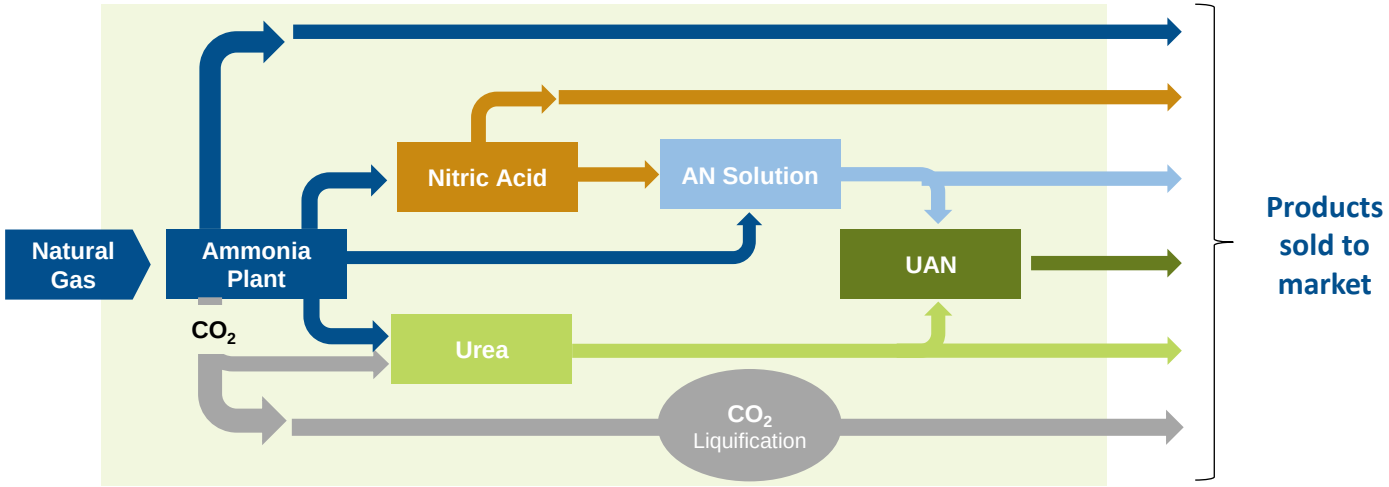
Business Overview

- LSB Industries, founded in 1968 and headquartered in Oklahoma City, OK, is a publicly traded company that manufactures and sells chemical products for the agricultural, mining and industrial markets
  - $550+m in annual revenue in 2021
- Three production facilities strategically located near customer demand areas
  - El Dorado, AR: Manufactures ammonia, ammonium nitrate, nitric acid, sulfuric acid, CO_2 and AN solution
  - Cherokee, AL: Manufactures UAN, ammonia, AN solution, nitric acid, CO_2 and diesel exhaust fluid
  - Pryor, OK: Manufactures UAN, ammonia and CO_2

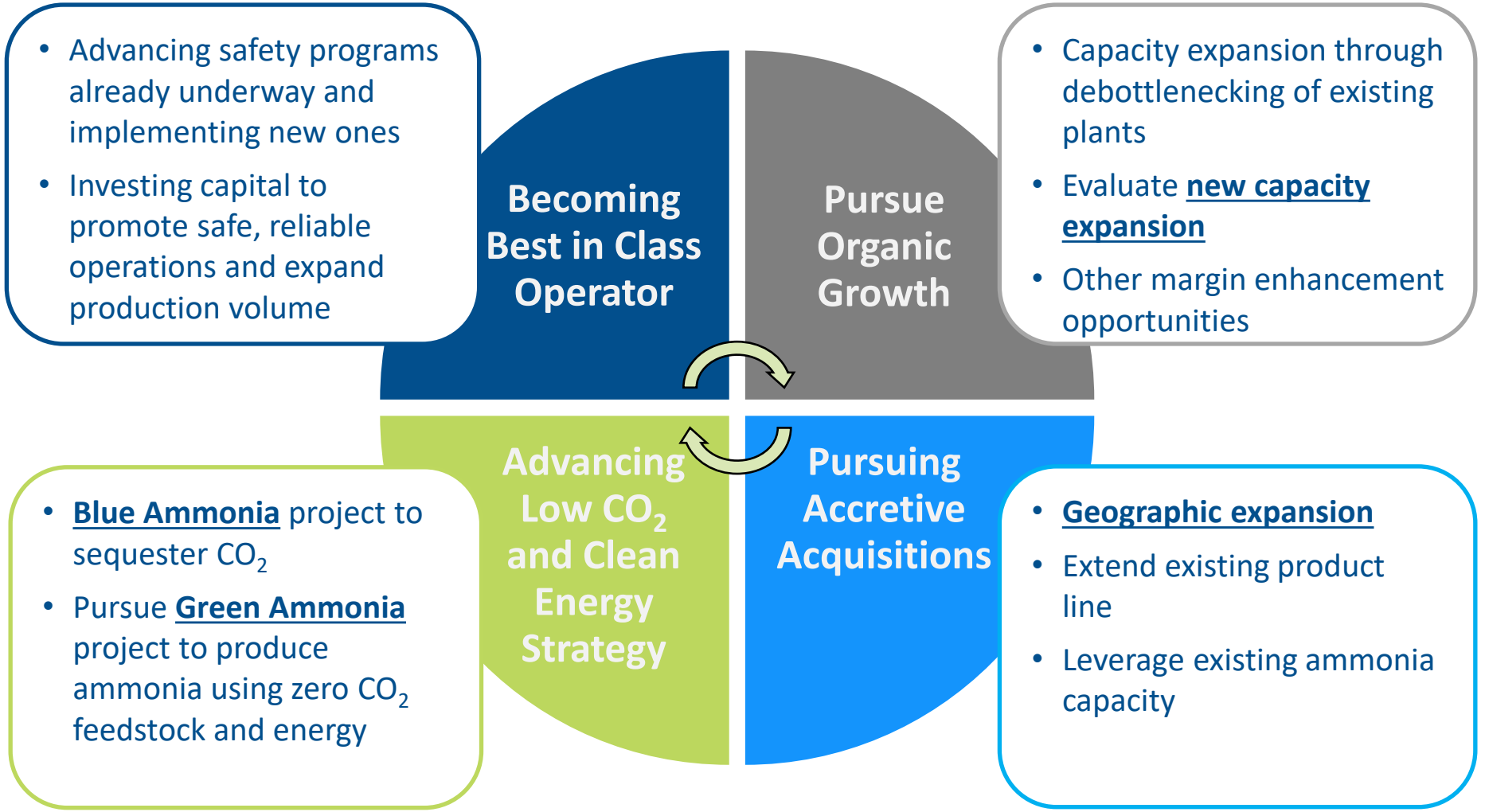


Revenue by Business

LSB is the fifth largest ammonia producer in the U.S.



LSB Industries Growth Initiatives



- Advancing safety programs already underway and implementing new ones
- Investing capital to promote safe, reliable operations and expand production volume

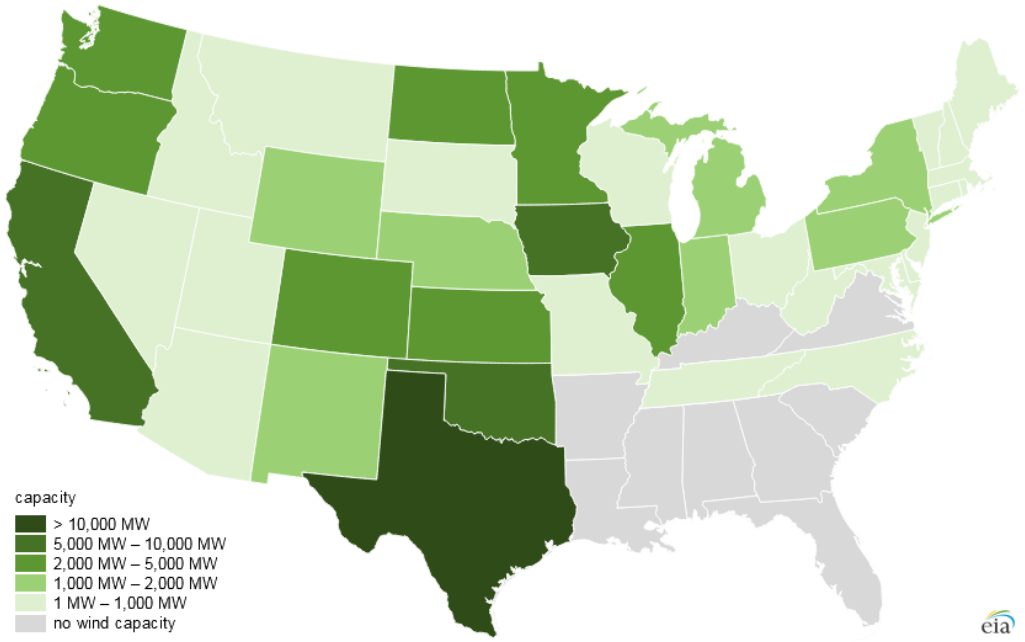
- Capacity expansion through debottlenecking of existing plants
- Evaluate **new capacity expansion**
- Other margin enhancement opportunities

- **Blue Ammonia** project to sequester CO_2
- Pursue **Green Ammonia** project to produce ammonia using zero CO_2 feedstock and energy

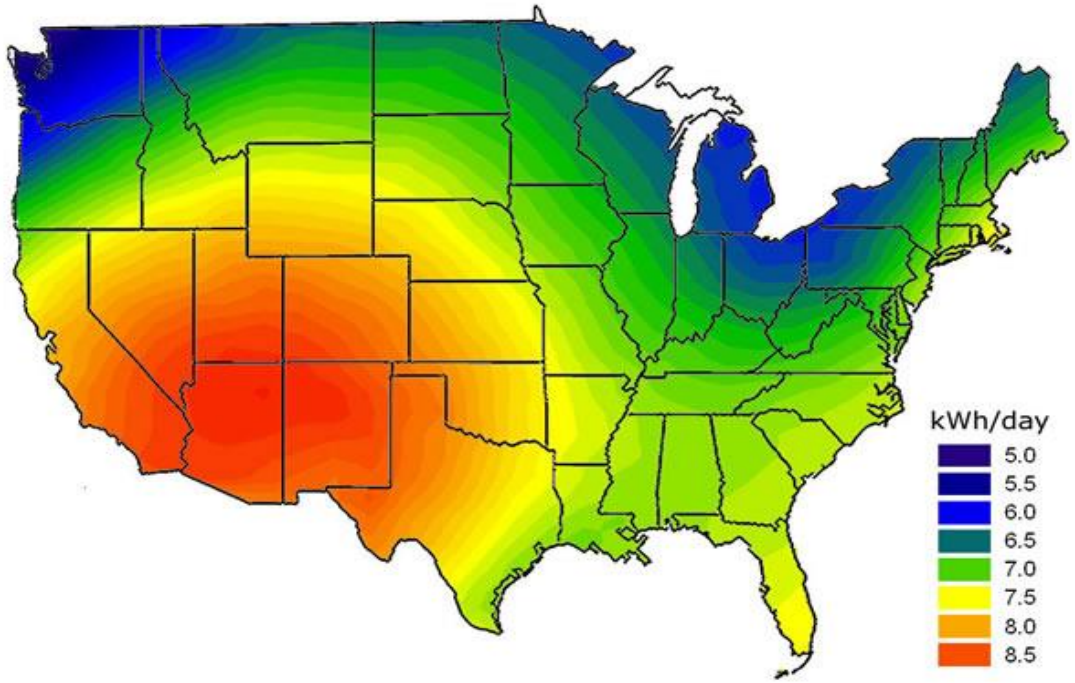
- **Geographic expansion**
- Extend existing product line
- Leverage existing ammonia capacity

US renewable power generation potential

Wind generating capacity



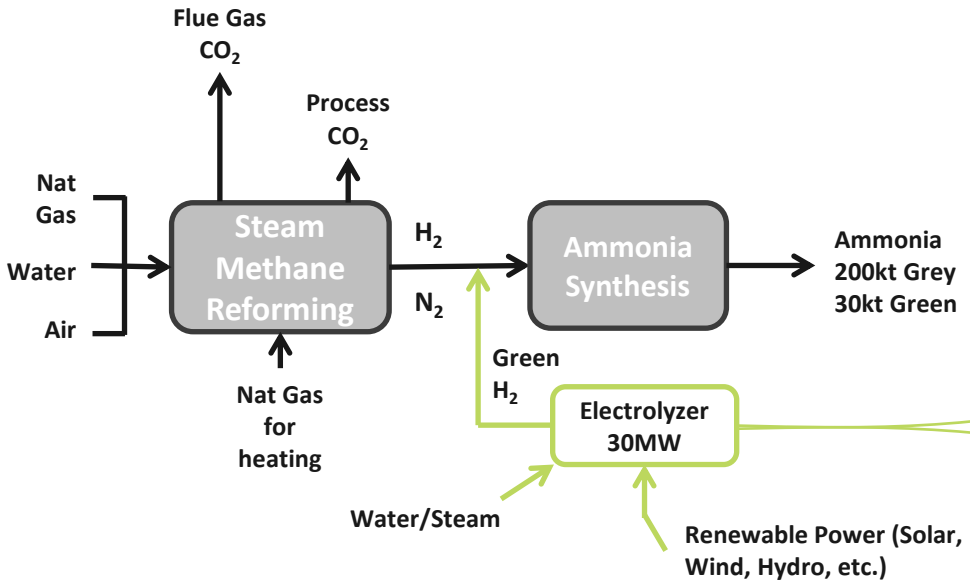
Solar generating capacity



- Oklahoma has great opportunities for new wind and solar power generation facilities
- The state higher renewable power generation efficiencies drive lower production costs per MWh

Source: Energy Information Administration, National Renewable Energy Laboratory

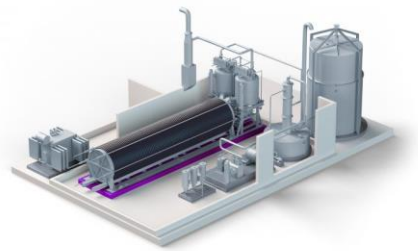
Zero carbon ammonia project at Pryor, OK



Bloom Energy – 10MW Solid Oxide Electrolyzer

Thyssenkrupp – 20MW Alkaline Electrolyzer

Nel Hydrogen – 20MW Alkaline Electrolyzer



- Completed a feasibility study to retrofit an existing ammonia plant and replace a portion of the conventional hydrogen with green hydrogen, producing 30k metric tons of green ammonia per year
- Expecting operations to begin by 2024. 10 MW Bloom SOEC electrolyzer and 20 MW of alkaline technology
- Electrolyzers will operate on renewable power from solar and wind facilities and the plant CO_2 emissions will decline by ~36k metric tons per year
- Expecting to offset hydrogen production costs using clean hydrogen tax credits of up to $3 per kg