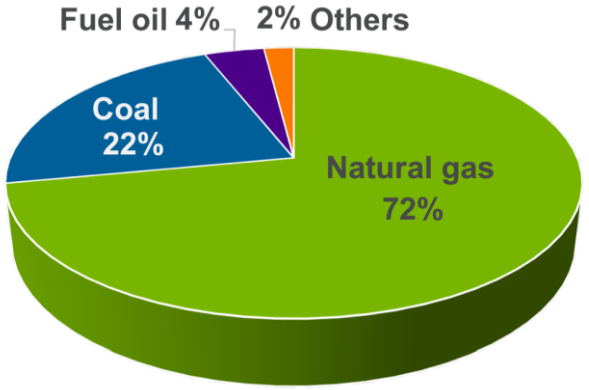
# Establishing the Toolkit for Decarbonizing Existing Gas-based Ammonia Plants

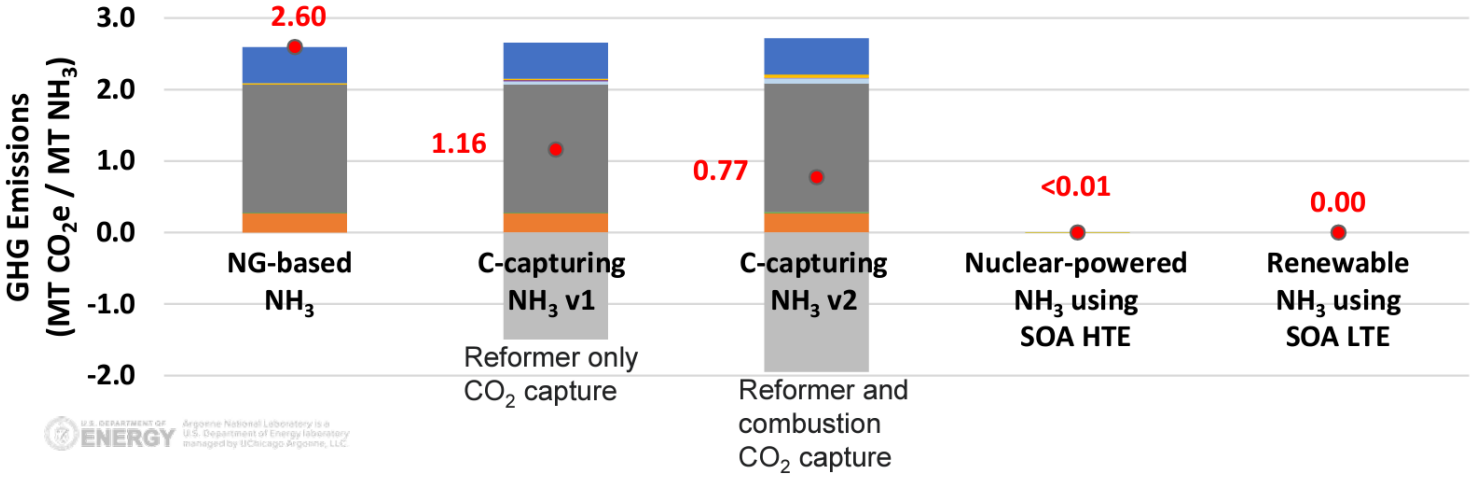
pioneering methane certified gas

SETTING THE STANDARD FOR METHANE EMISSIONS

# NATURAL GAS IS AN IMPORTANT INGREDIENT FOR AMMONIA PRODUCTION

- 72% of Global Ammonia Production uses natural gas as a feedstock
- Well-to-gate missions from Natural gas can vary on an order of several factors depending on Methane Leakage (<0.20% to >>4.0% methane loss)
- Resulting emissions from natural gas can have significant impact on ammonia carbon footprint




GREET H2IQ webinar, 2022

- $H_2$, $N_2$ Production Upstream Emissions for NG Use
- $H_2$, $N_2$ Production Upstream Emissions for Electricity Use
- $H_2$, $N_2$ Production Onsite Emissions
- HB Loop Upstream Emissions for Electricity Use
- Boiler Flue Gas Onsite Emissions
- $CO_2$ Capture and Compression Upstream Emissions for Electricity Use
- $CO_2$ Transport Upstream Emissions for Electricity Use
- Captured Onsite $CO_2$ Emissions
- Net WTG GHG Emissions

# MIQ EMISSIONS GRADING

1

**Calculated Intensity**

$$= \frac{\text{Methane emitted (gas allocated)}}{\text{Natural gas throughput}}$$

2

Extensive **Monitoring Technology Deployment** on Facility- and Source-Level

3

**Company Practices**
Policies and procedures for methane emissions management

**Third-party accredited Auditors:** audit, verify and report

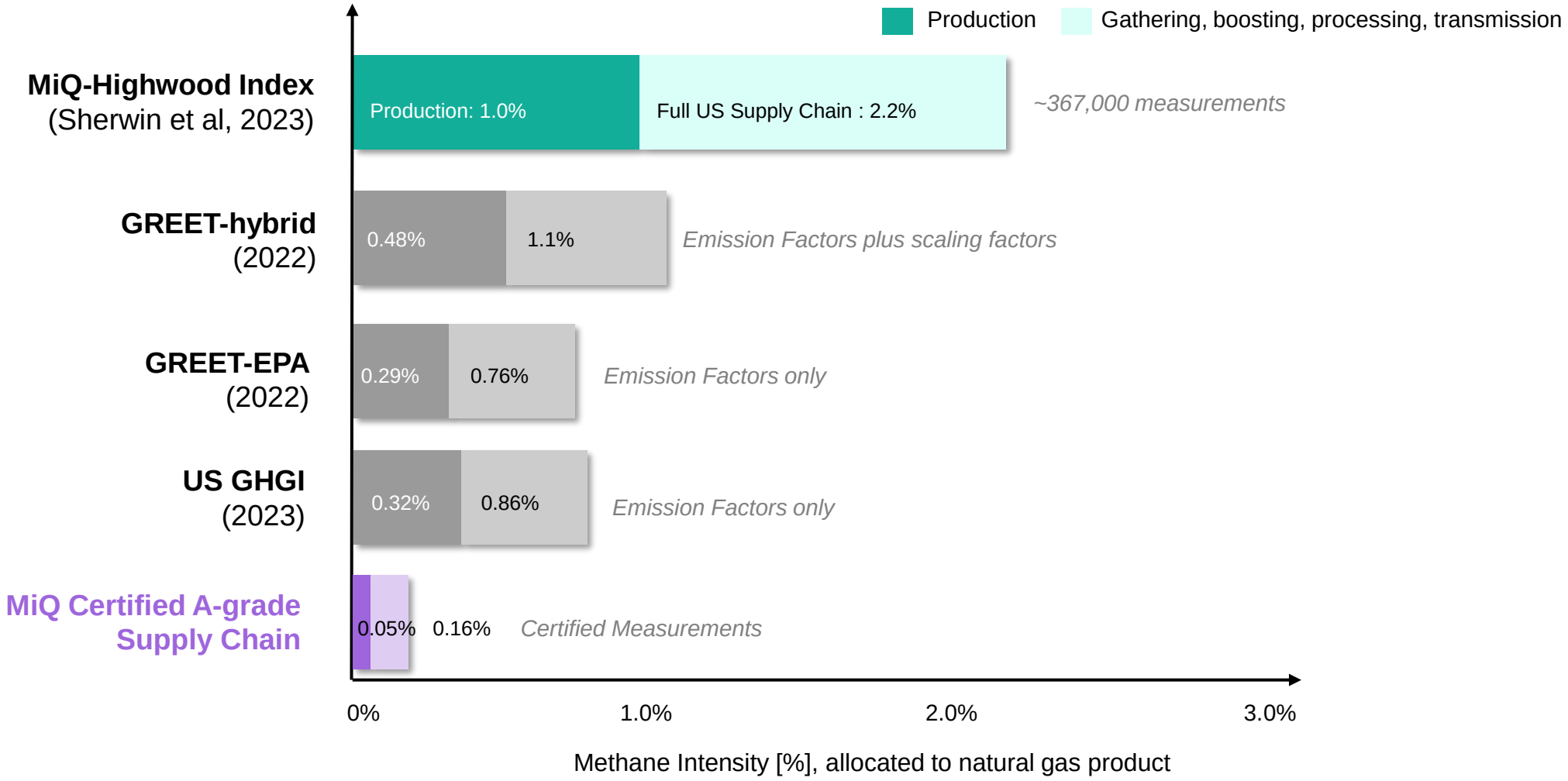
| | $gCH_4$/MMBtu | | | |
|---|---|---|---|---|
| ≤ 0.050% | 10 | Quarterly | Stringent | **A** |
| ≤ 0.10% | 19 | Tri-annually | High | **B** |
| ≤ 0.20% | 38 | Semi-annually | Medium | **C** |
| ≤ 0.50% | 95 | Annually* | Mandatory minimum | **D** |
| ≤ 1.0% | 190 | Annually* | Mandatory minimum | **E** |
| ≤ 2.0% | 381 | Annually* | Mandatory minimum | **F** |

** Source-level only*

1. **MiQ Standard** is public and transparent, open for scrutiny.
2. MiQ Offers **CH4 Certification** plus **CO2e Intensity Certification**
3. MiQ certifies at **Asset Level** for each segment of the Natural Gas supply Chain
4. MiQ requires the use of Accredited **Third Party Auditors** to verify grades
5. Certificates of Emissions Attributes held in **MiQ Digital Registry**

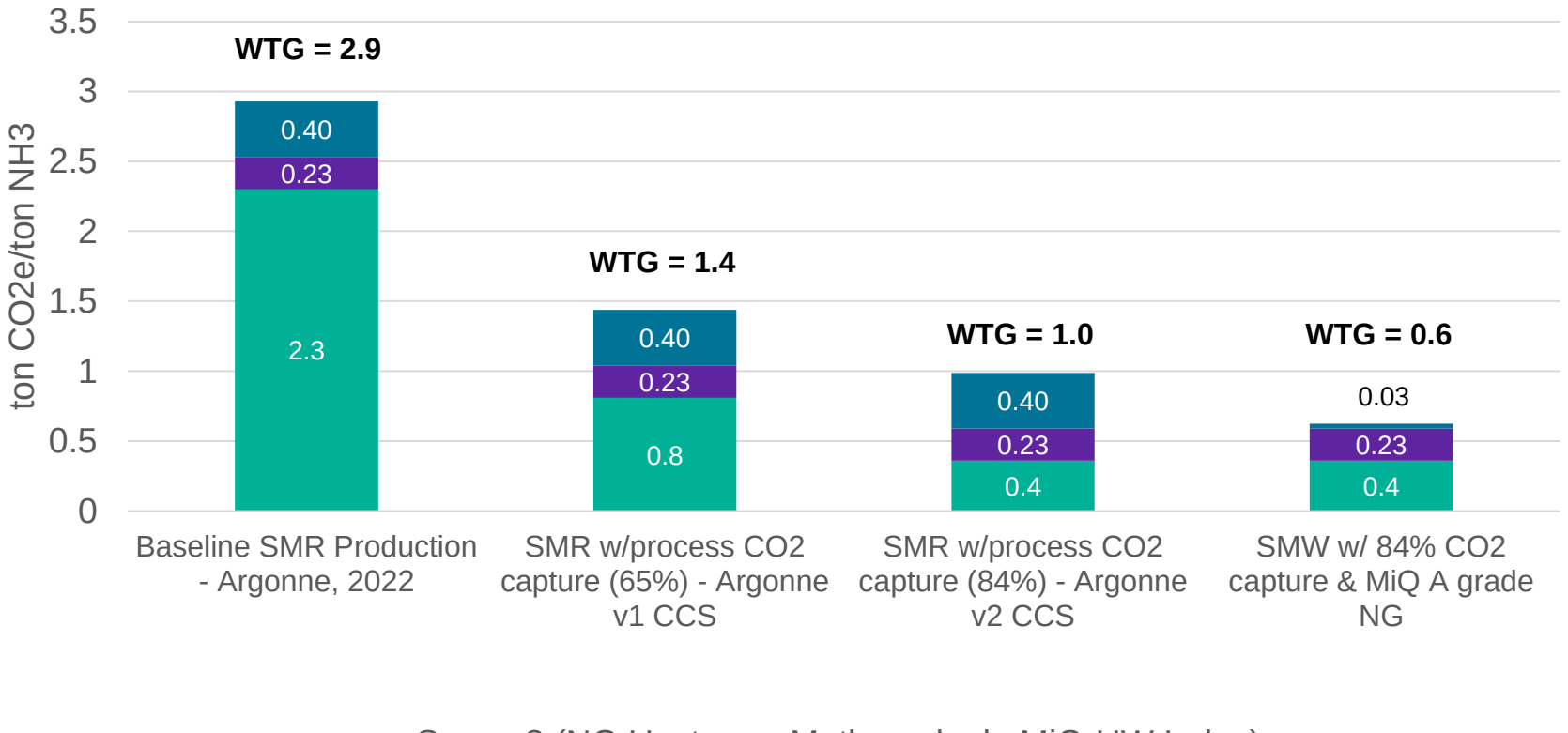
SETTING THE STANDARD FOR METHANE EMISSIONS

# CERTIFIED METHANE EMISSIONS OFFER SIGNIFICANT REDUCTIONS COMPARED TO BASELINES



SETTING THE STANDARD FOR METHANE EMISSIONS

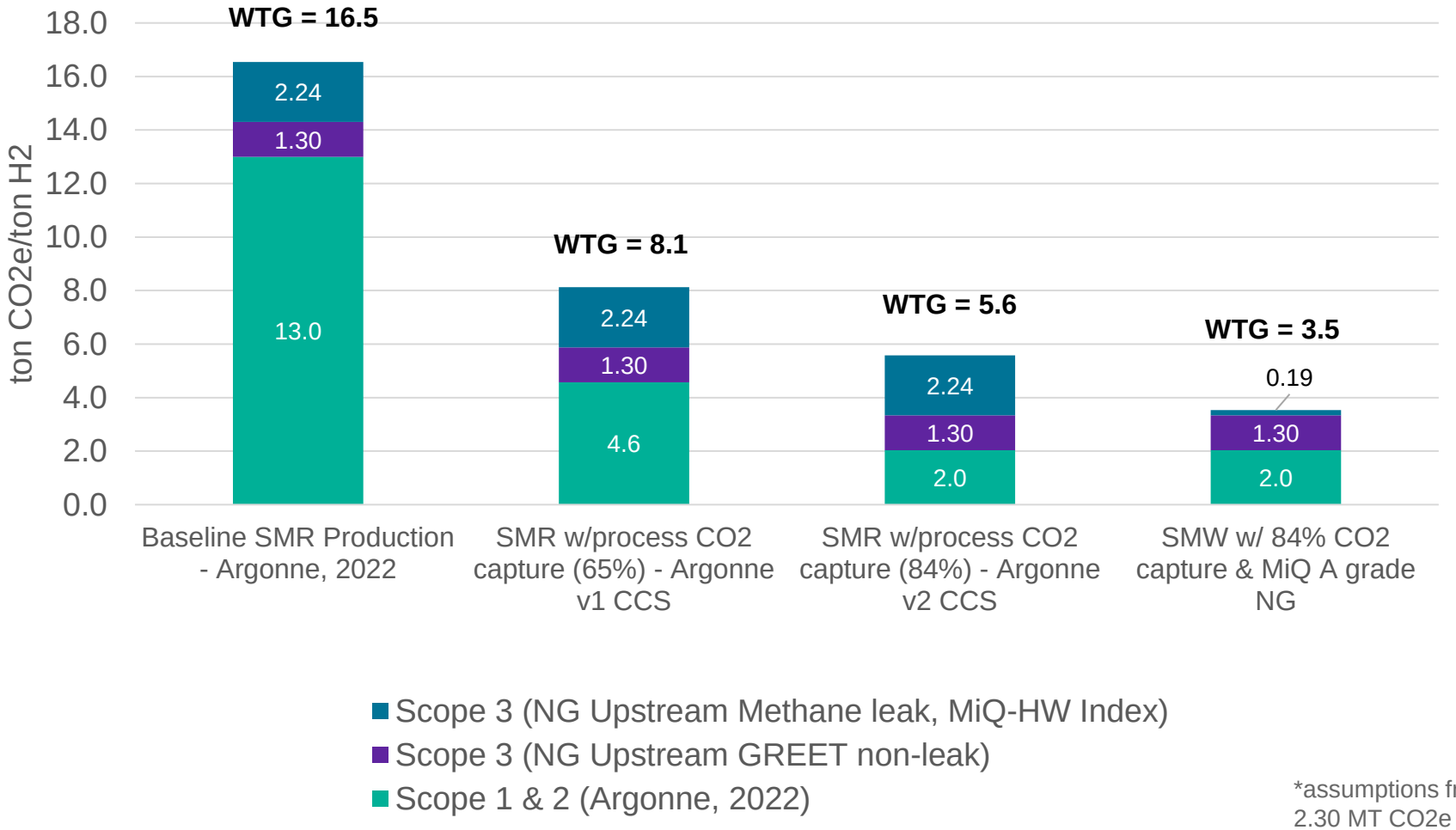
# IMPACT OF LOW METHANE NATURAL GAS ON AMMONIA CARBON INTENSITY




*assumptions from Lee et al, 2022 (Argonne):
2.30 MT CO2e per MT NH3 for conventional process
32.5 GJ NG per MT NH3 for feedstock + fuel use
47.1 MJ/kg NG LHV

SETTING THE STANDARD FOR METHANE EMISSIONS

# IMPACT OF LOW METHANE NATURAL GAS ON BLUE-HYDROGEN CARBON INTENSITY

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