Considerations for Estimating Life Cycle Emissions for Iron and Steel Processes

NATIONAL ENERGY TECHNOLOGY LABORATORY

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Solutions for Today | Options for Tomorrow

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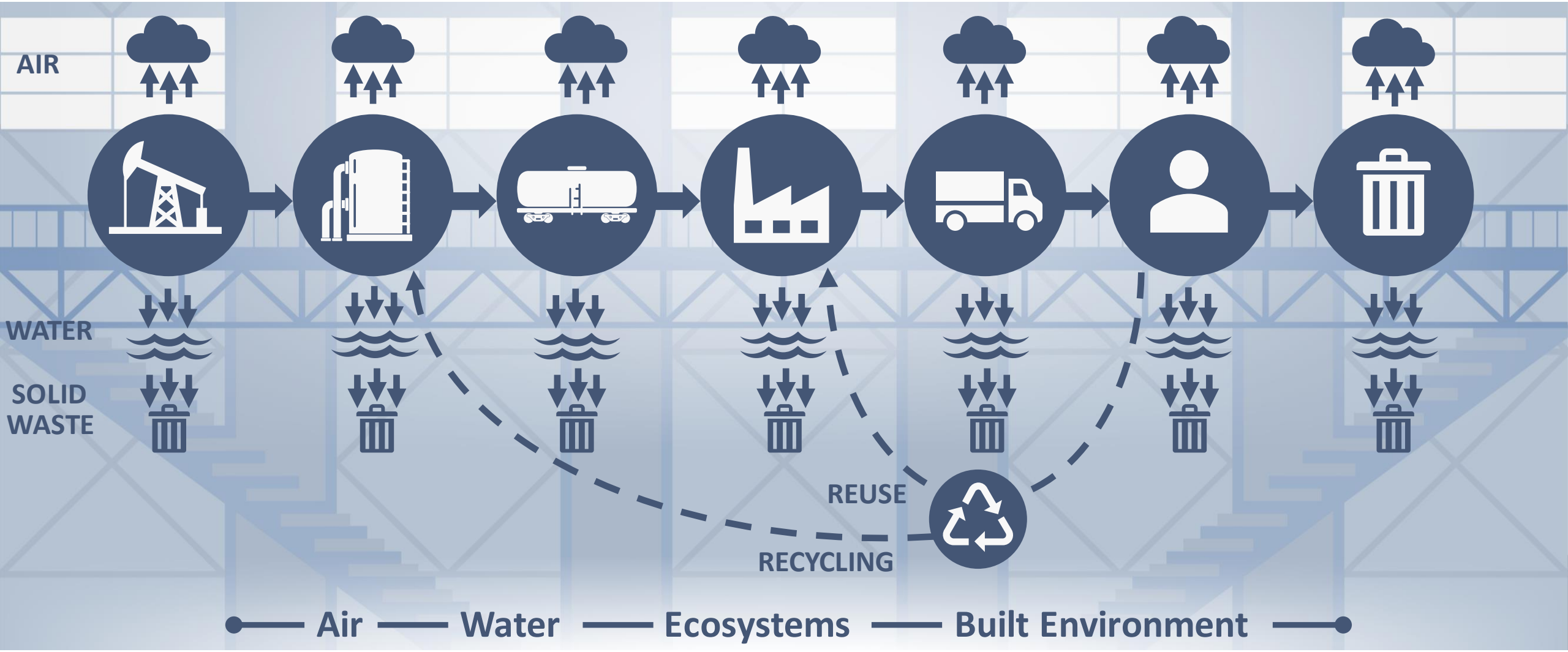
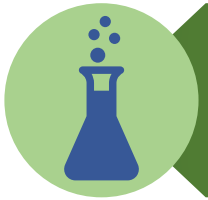
What Is Life Cycle Analysis?

What Is LCA?

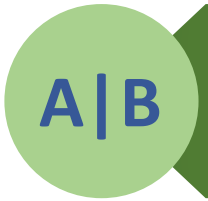

AIR
WATER
SOLID WASTE
REUSE
RECYCLING
Air
Water
Ecosystems
Built Environment

What Distinguishes LCA From Other Frameworks?

Connectivity between processes



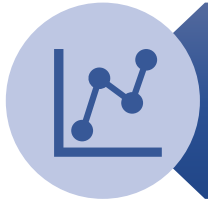
Depth and breadth of impacts considered



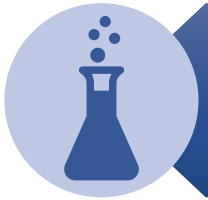
Comparability among systems

Standardized approach

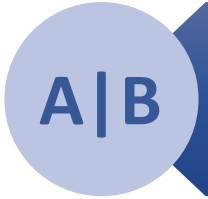
How Is LCA Used?



Establish National Baselines



Assess Emerging and Existing Technologies



Compare Technology and Scenario Tradeoffs

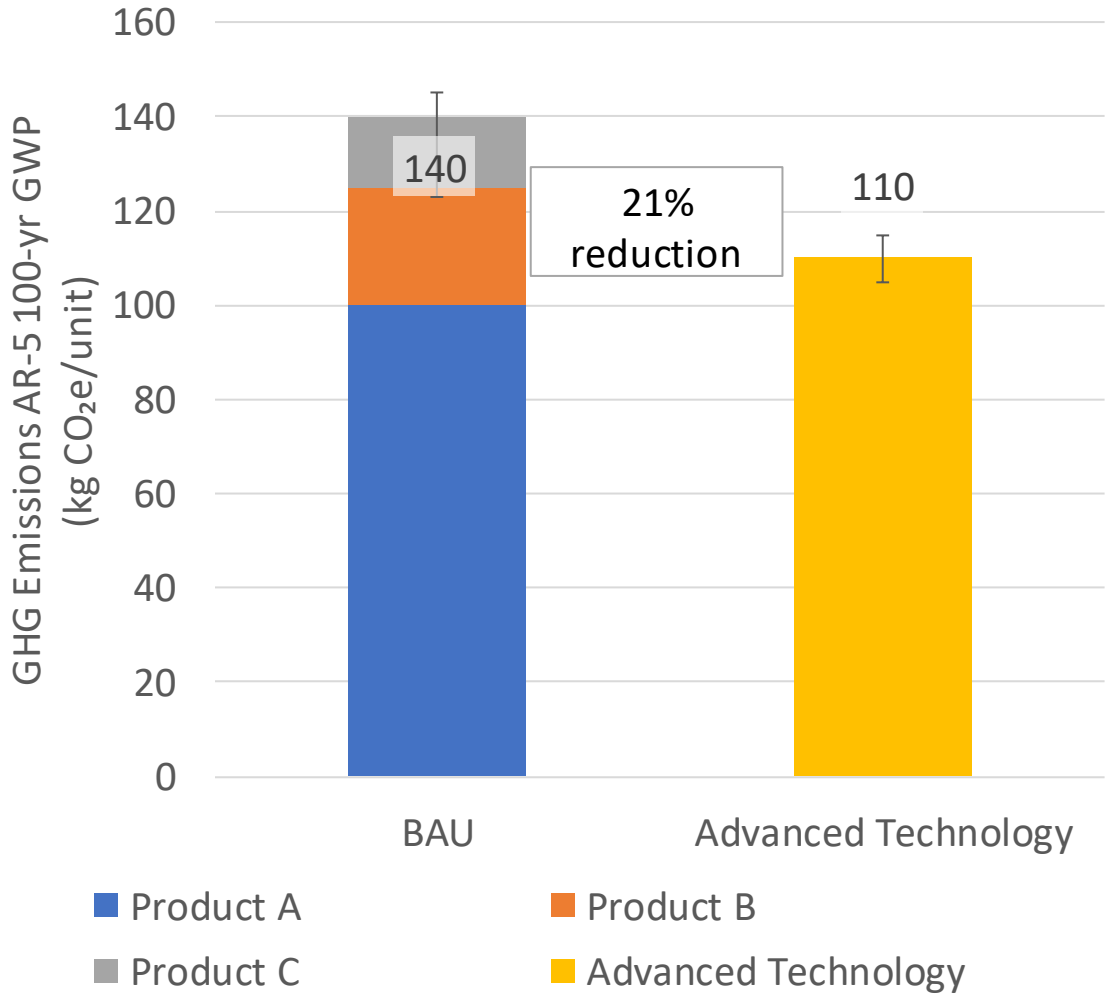
Plan for the Future and Look Ahead

BAU/Advanced Technology Comparison

Method Description

- Current "Business-As-Usual" (BAU) practices for creating co-products compared to a novel project with various advancements

- In this example, advanced technology produces three co-products that are produced by separate processes in BAU



Challenges for Performing Comparative LCAs

Not specific To Iron and Steel Making

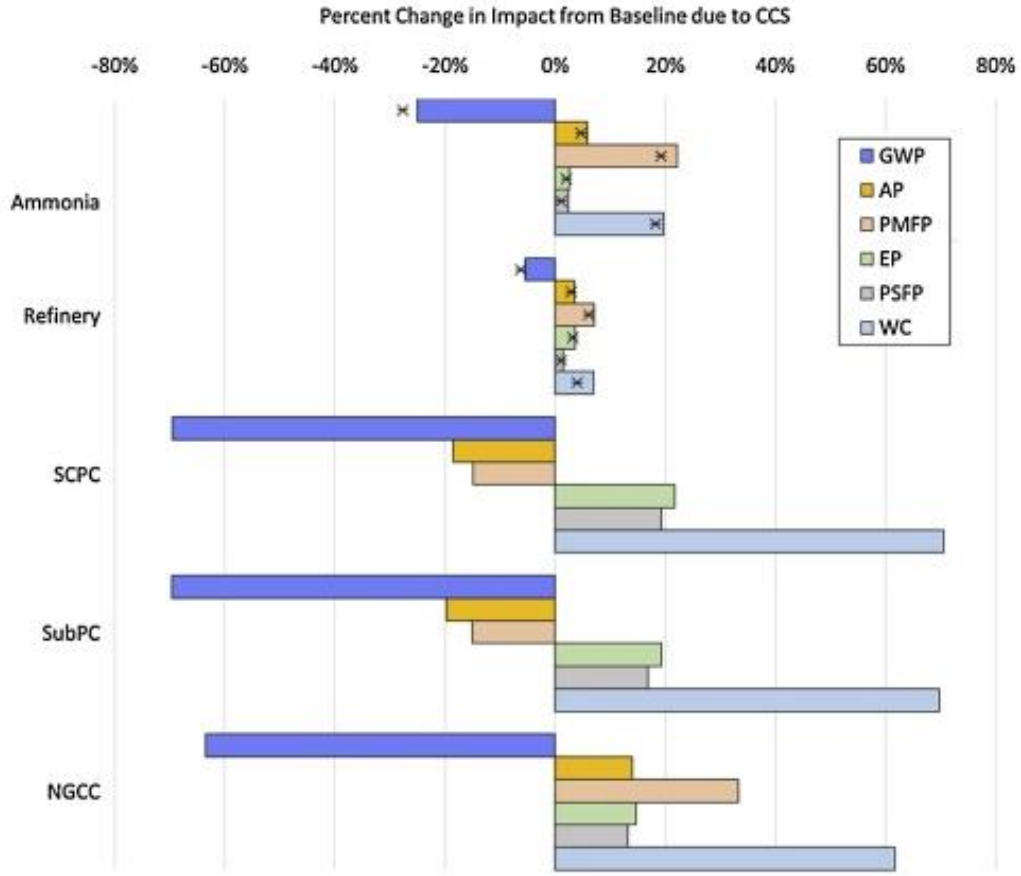
- Emerging technology uncertainty
  - Forecasting bench scale to industrial scale, science to engineering, learning curves
  - Changing supply chains, usage patterns
- Greenhouse gas accounting in a decarbonizing economy
  - Process may look good relative to 10 GT/yr. CO_2 economy, but not 50% of that
- Accounting for renewable energy
  - Multiple incentives across multiple jurisdictions have multiple entities claiming credit
- Impact Shifting
  - Decarbonization is the de facto improvement, but water, air quality, and resource availability remain critical regionally

Carbon Capture on Steel Production

Ongoing Industrial Sector Decarbonization Work

- Gate-to-gate inventory for steel production suitable for TRACI impact assessment sourced from national emissions inventories
- Amine-based carbon capture (based on NETL techno-economic analysis) applied to blast furnace
- Comparative assessment of CO_2 sequestered across industrial sectors[1]

Steel	
Estimated U.S. Production	95 million tons
Estimated U.S. Facilities	120
Facility Count (% of production)	
GHGRP	112 (90%+)
NEI	94 (90%+)
TRI	91 (55%)
DMR	60 (55%)



[1] Consistent with the approach documented for other industrial sectors in Young, B., Krynock, M., Carlson, D., Hawkins, T. R., Marriott, J., Morelli, B., ... & Skone, T. J. (2019). Comparative environmental life cycle assessment of carbon capture for petroleum refining, ammonia production, and thermoelectric power generation in the United States. *International Journal of Greenhouse Gas Control*, 91, 102821.

LCA Guidance

Calculating Qualified Carbon Oxide Utilization for 45Q

- 26 CFR Part 1, Section 1.**45Q**-4 requires LCA to be performed to document the amount of qualified carbon oxide for the utilization tax credit
- The final declaration preamble directs taxpayers to use the NETL CO_2 Utilization Guidance Toolkit for LCA guidance

The CO2U Guidance Toolkit is available at: netl.doe.gov/LCA/CO2U

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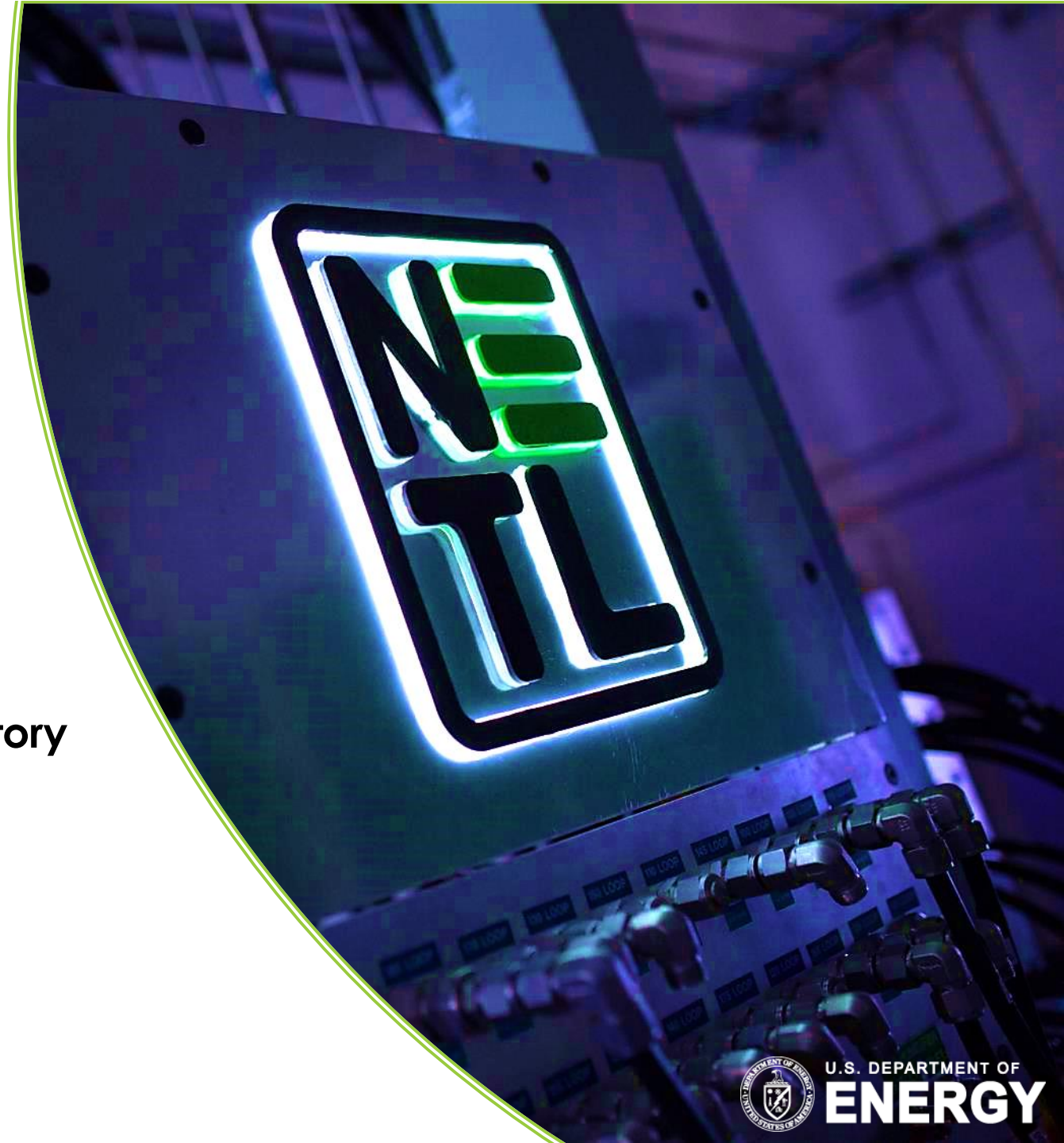

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