# LCRI
## LOW-CARBON RESOURCES INITIATIVE

# Enabling the Pathway to Economy-Wide Decarbonization

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

www.lowcarbonLCRI.com



gti

# The Path to 2050: Enabling an Affordable and Reliable Clean Energy Transition

## Briefing to EAC Energy Storage Subcommittee

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# Reimagining the Future Energy System

## Decarbonization

~10-15 years

Accelerate economy-wide, low-carbon solutions

- Electric sector decarbonization
- Transmission and grid flexibility: storage, demand, EVs
- Efficient electrification

~15-30 years

Achieve a net-zero clean energy system

- Ubiquitous clean electricity: renewables, advanced nuclear, CCUS
- Negative-emission technologies
- Low-carbon resources: hydrogen and related, low-carbon fuels, biofuels, and biogas

## Transformation

Drive affordability of a clean and resilient energy system through digital transformation

- Power system modernization: pervasive sensors, monitoring, advanced analytics using AI
- Upgraded and expanded communications infrastructure and control systems

## Resiliency

~10-15 years

Mitigate climate impacts and cyber/physical risks

- System and asset hardening
- Improved response
- Faster recovery
- Cybersecurity

~15-30 years

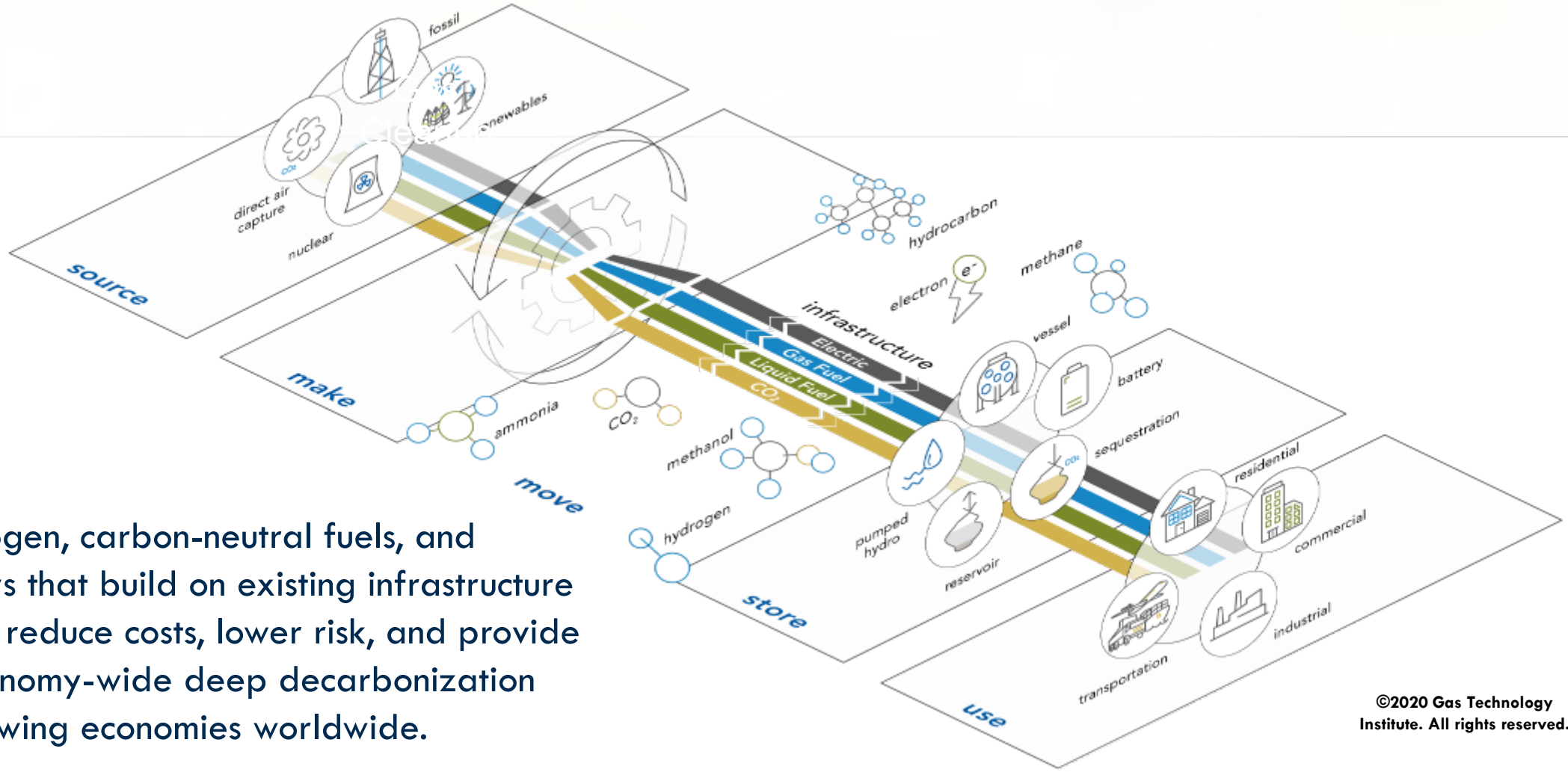
Future proof energy system design basis

- Resilient power system design
- Advanced asset design and strategic undergrounding
- Smart integration of energy carriers

**Making Energy More**

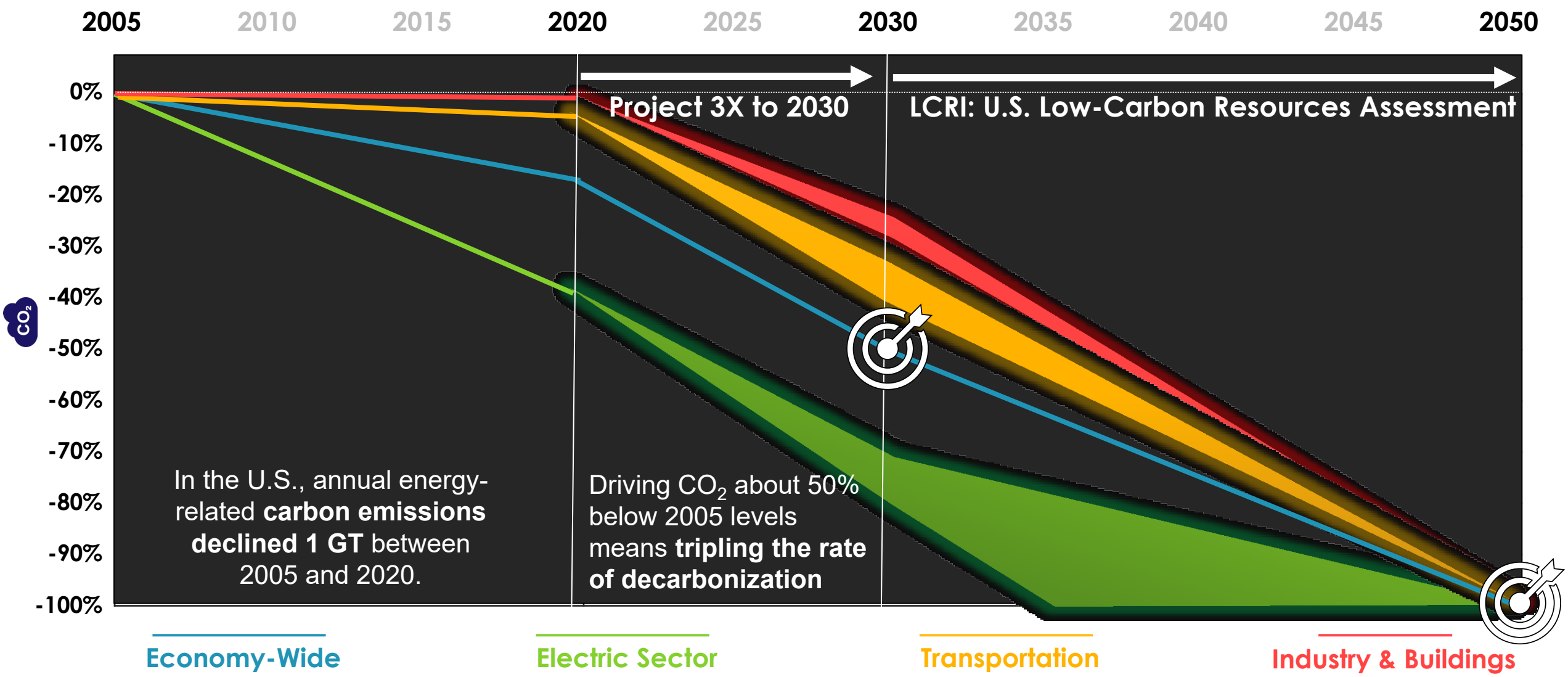
**Clean** | **Affordable** | **Reliable**

# GTI sees a carbon-managed future where integrated energy systems leverage low-carbon fuels, gases, and infrastructure.




Deploying hydrogen, carbon-neutral fuels, and chemicals in ways that build on existing infrastructure and systems can reduce costs, lower risk, and provide pathways to economy-wide deep decarbonization that support growing economies worldwide.

# Examining U.S. Carbon Reduction Goals




https://www.youtube.com/watch?v=42UqxqCCYs4

The **Low-Carbon Resources Initiative** (LCRI) is a five-year R&D commitment focused on the advancement of low-carbon technologies for large-scale deployment across the energy economy. This initiative is jointly led by **EPRI and GTI**.

## FOCUS

**Multiple options and solutions** to establish viable low-carbon pathways

**Technologies for hard-to-decarbonize** areas of the energy economy

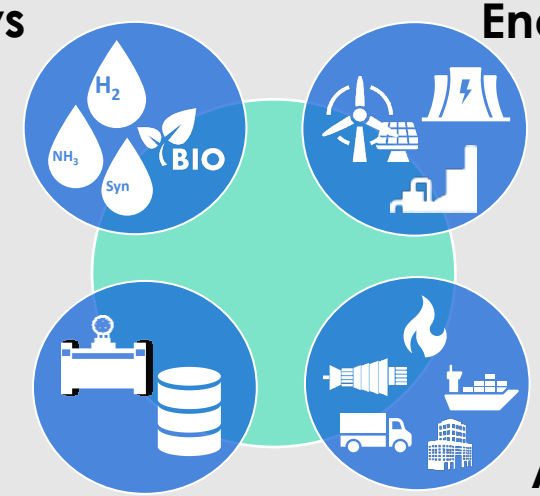
**Affordable, reliable, and resilient** integrated energy systems for the future

## RESEARCH AREAS

**Hydrogen** **Ammonia** **Synthetic/ Derivative Fuels** **Biofuels**

**Production Pathways**

**Integrated Energy Systems**




**Storage & Delivery**

**End Use Applications**

## VALUE

**Independent, objective research** leveraged by global engagement and collaboration

**Comprehensive value chain approach** across adjacent sectors

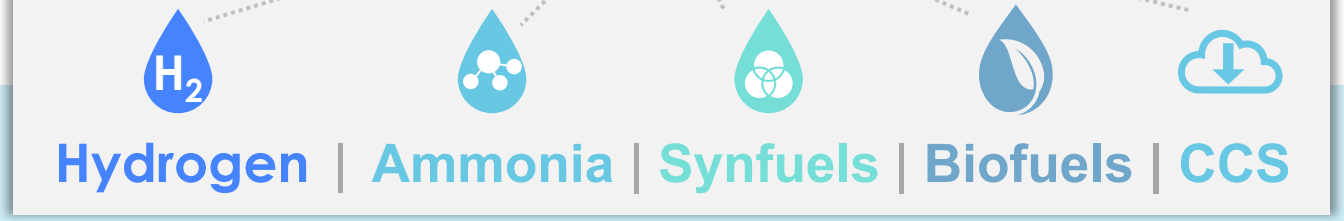
**High-impact results** that accelerate technology time to market

2020 | 2030 | 2050+

# Beyond 2030

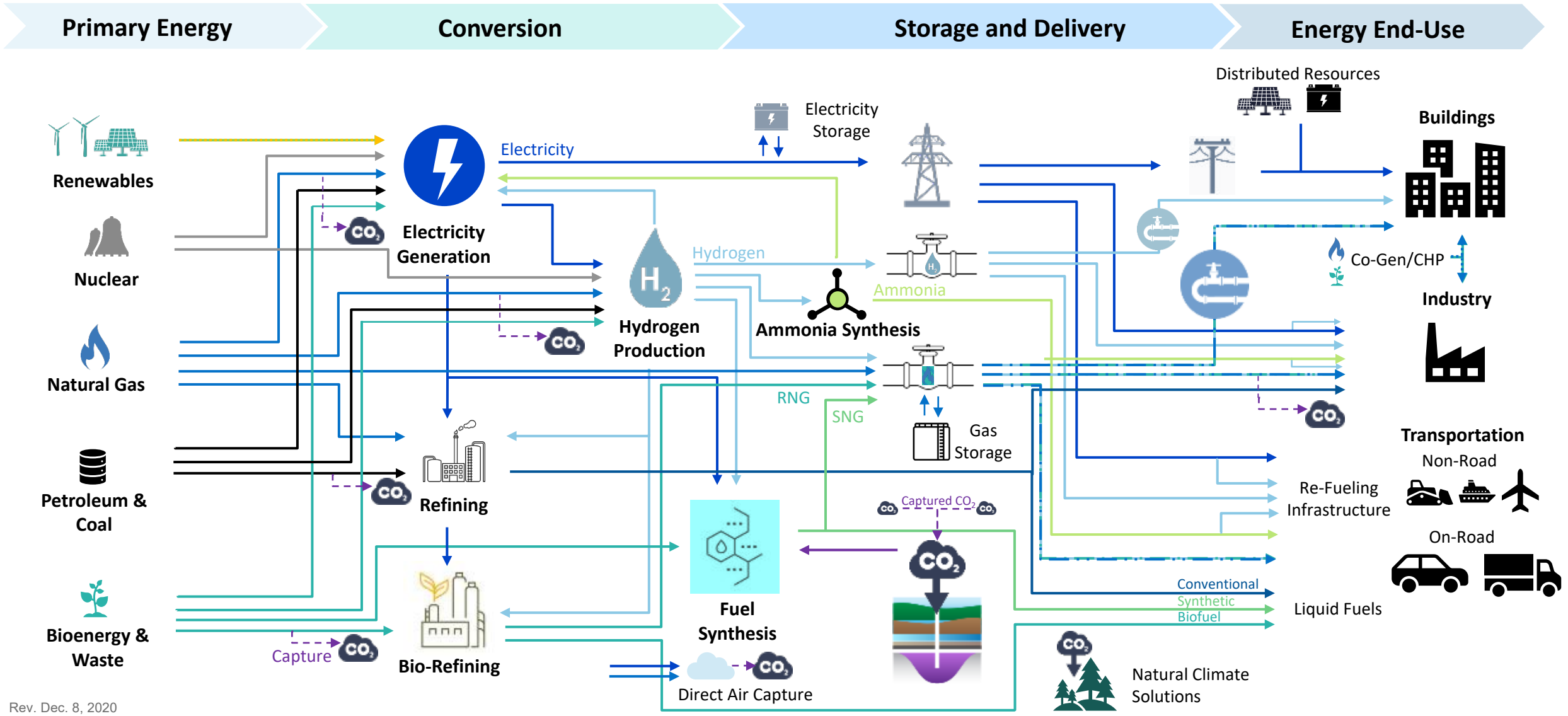
LCRI Focus:

**How might value chains incorporate low-carbon energy carriers?**




- Renewable Fuels
- Hydrocarbon-Based Processes
- Electrolytic Processes
- Delivery & Storage
- Power Generation
- Transportation, Industry, & Buildings
- Safety and Environmental Aspects
- Integrated Energy System Analysis

# Low-Carbon Energy Ecosystem

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# LCRI Sponsorship


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aps
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Black & Veatch
CenterPoint Energy
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LES
LA DWP Los Angeles Department of Water & Power
Missouri River Energy Services
Mitsubishi Power
National Fuel
nationalgrid
Nebraska Public Power District
New York State of Opportunity. NY Power Authority
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# LCRI Public Website: www.lowcarbonlcri.com

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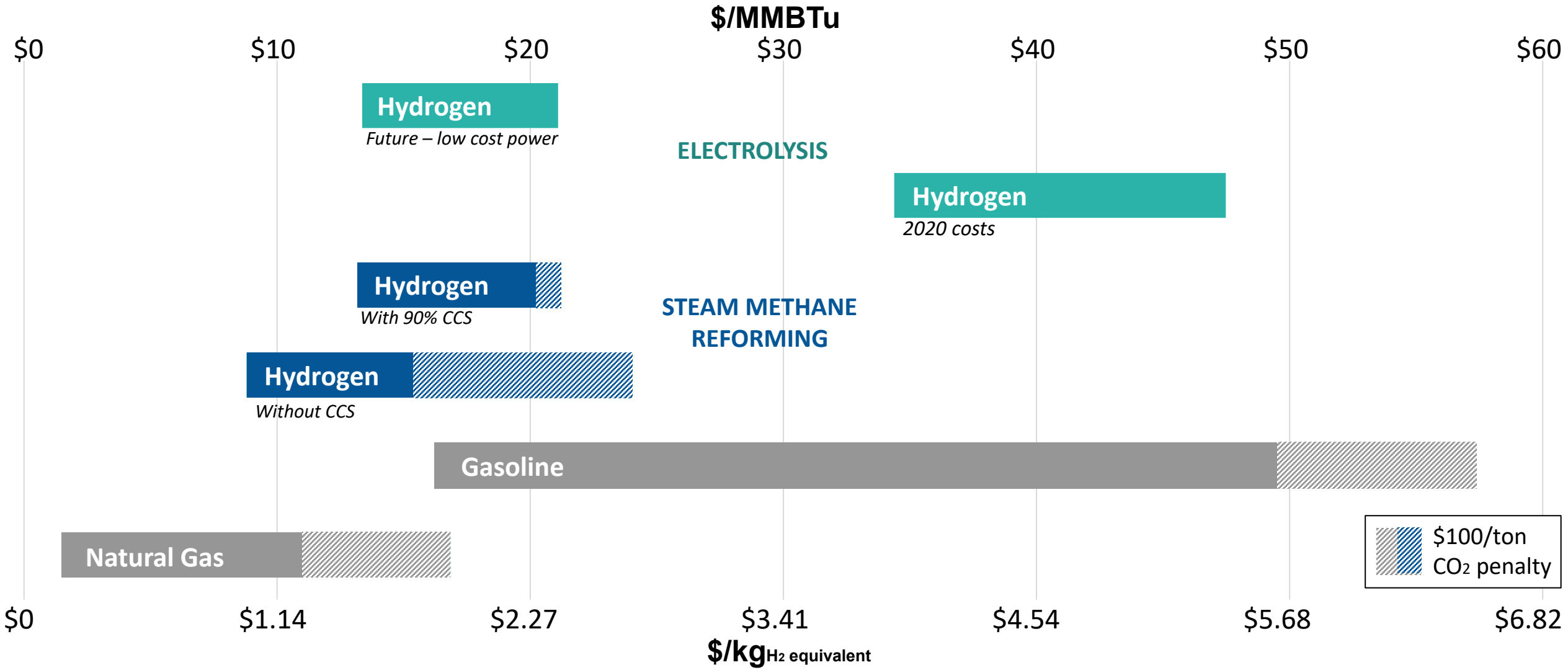
# Example Technology Cost Insight

## Energy Cost (USD/MMBTU and USD/kg$_{H_2eq.}$)

Initial calculations. For discussion purposes only.




*Source: EPRI analysis, based on data from: IEA, "The Future of Hydrogen" (2019); EPRI, "Prospects for Large-Scale Production of Hydrogen by Water Electrolysis" (2019); commodity price data.*

# Beyond 2030 - Hydrogen/Clean Electricity Production

## $H_2$ Production

Advanced Nuclear

Next Gen Electrolysis

Existing Clean Generation

Natural Gas CCS

## $H_2$ Delivery

Utilize Existing Natural Gas Pipeline through Blending

Shipping and Trucking

## $H_2$ End-Use

Boiler

Heavy Duty Transportation

Electric Generation

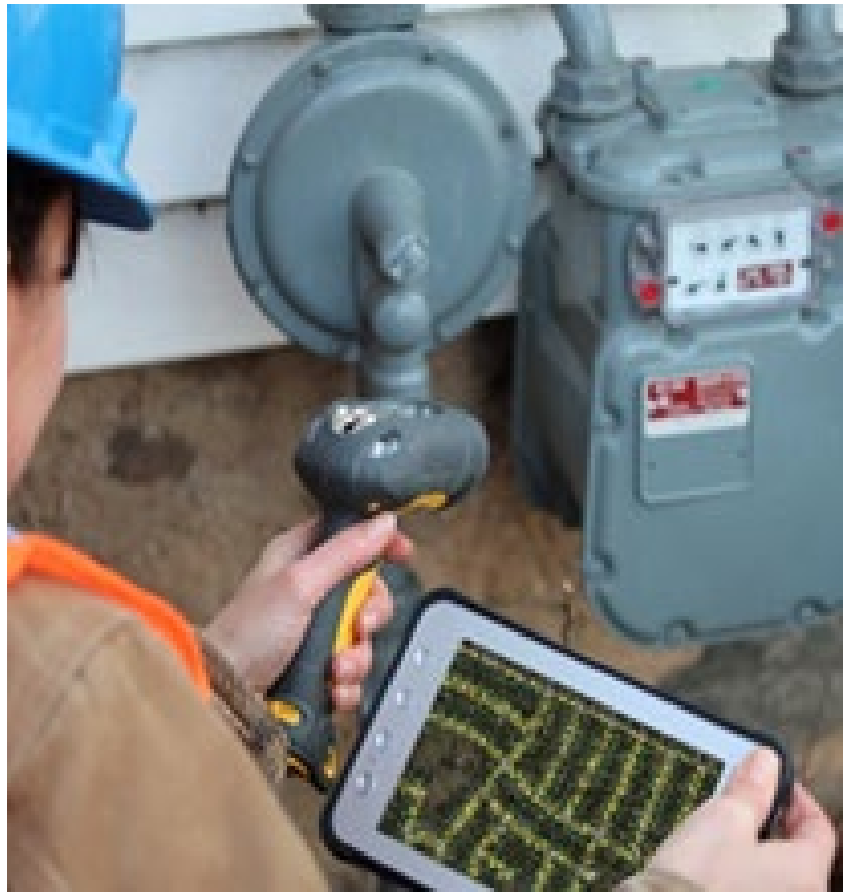
Advanced Fuel Cell

Large Industry

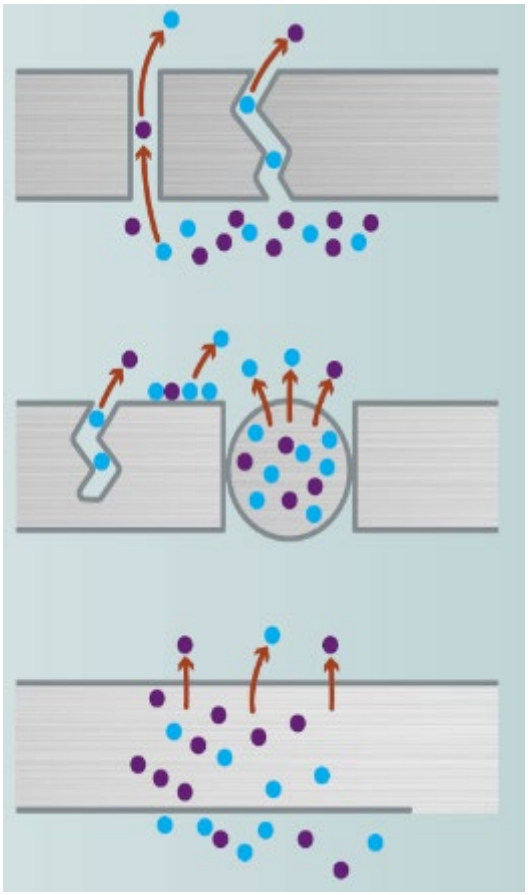
Chemical Process

# Impacts on Pipeline Applications

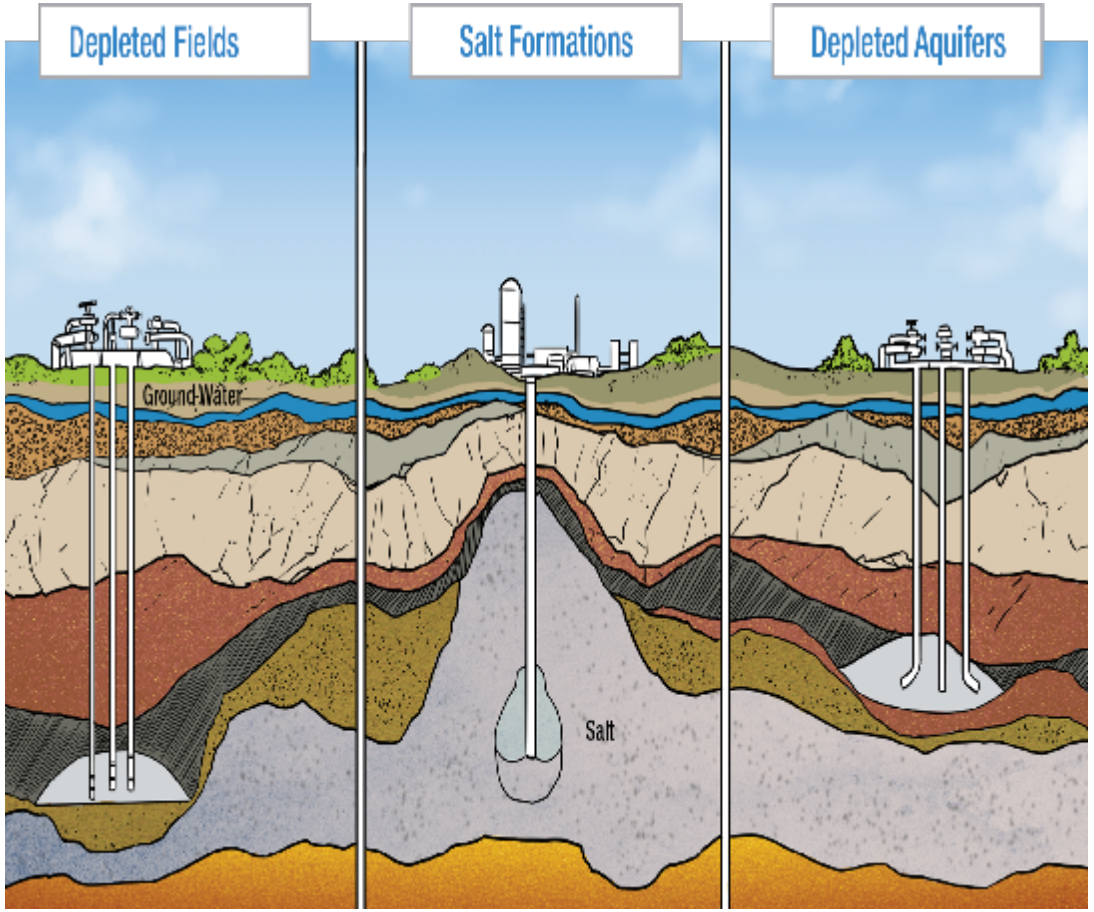
## Metering Calibration



## Leakage & Monitoring

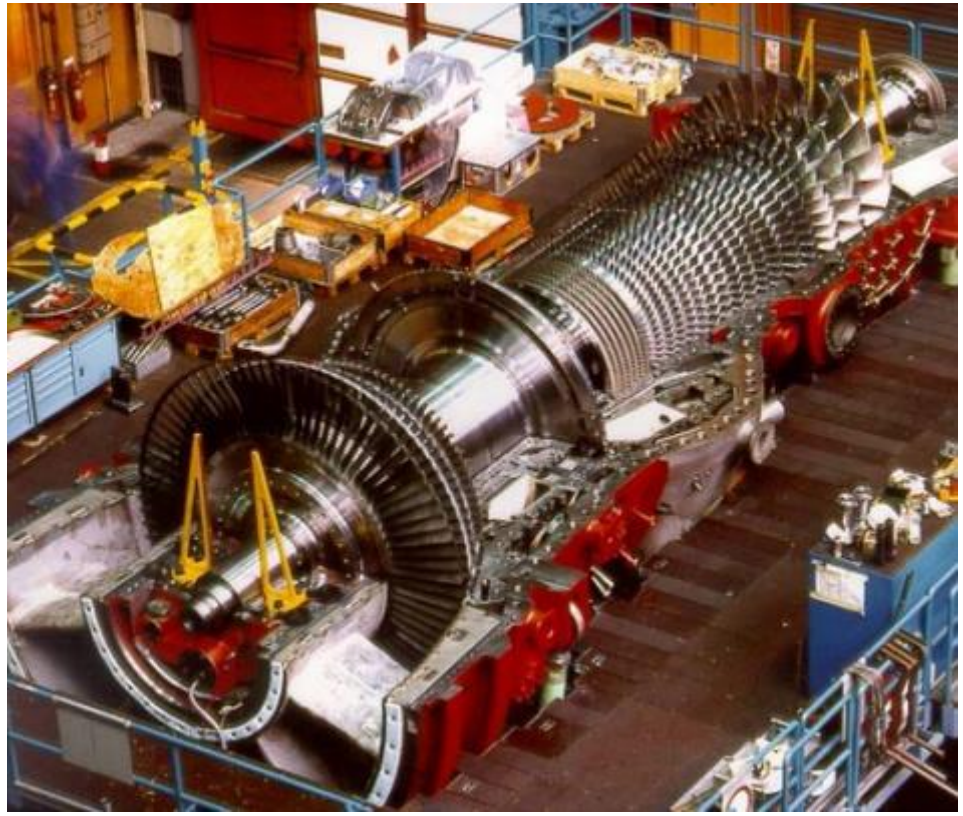


## Compression & Underground Storage



# Impacts on End Use Applications

## Industrial Scale Gas Turbines



## Natural Gas Vehicles/ HD Trucks


## Residential / Commercial