BURNS McDONNELL

Decarbonization Journey Update

October 8, 2024

GSTC

GLOBAL SYNGAS

TECHNOLOGIES COUNCIL

Burns & McDonnell – At a Glance

TOP
5%
SAFETY RANKINGS

13,500
EMPLOYEES

$6B
REVENUE

60+
OFFICES WORLDWIDE

1898
FOUNDED

100%
EMPLOYEE OWNED

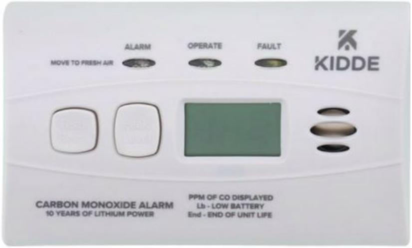
Safety Moment

Install / Inspect CO Monitor

- Natural gas boiler failure
  - Obstruction in exhaust overheated condensing boiler
  - Overheating severely damaged flue gas exhaust seal
  - Boiler trouble code, so cover temporarily removed
  - Technician measured high concentration of CO near damaged seal

- Local CO monitor unplugged, and battery removed
  - Spouse did in middle of night while traveling for business…

- Need to ensure ENTIRE family understands the serious aspect of a CO alarm



Agenda

- Legislative and Legal Update
- Hydrogen & Ammonia
- Carbon Capture & Storage
- Future for Syngas

Legislative and Legal Update

The Decarbonization Investment

IIJA

Infrastructure Investment and Jobs Act

\+

IRA of 2022

Inflation Reduction Act of 2022

Jump-start Investment

Economic Engine

IIJA Update

- Extremely slow progress by DOE in distributing grants
- Hydrogen
  - Hydrogen hub funding for 7 hubs in year-long negotiations
  - $90 million released to 3 hubs for study and analysis
  - Awarded at 15% cost match, not 50% as many potential projects assumed
- Carbon Capture
  - Pilot (80%) and demonstration (50%) projects awarded and in negotiations
- Direct Air Capture
  - DOE awarded 2 projects, announced another round of funding
- Loan Program Office (LPO)
  - Only $10 billion loaned out of $400 billion available
  - Becoming the preferred choice over DOE grants
  - Equipped to take “FOAK” (First of a Kind) risks

Status of IRA of 2022

- Values included in bill based on DOE “cost of production” models
  - Considered CHEAP renewables or curtailed power for hydrogen
  - Aspirational DOE direct air capture value ($180/ton versus $800+/ton actual)

- Hydrogen
  - Treasury issued guidance requiring only new renewables and no nuclear
  - Treasury will revise final guidance by end of 2024
  - Yearly inflation adjustment starts in 2026

- Carbon Capture
  - Coal potential to clear $85 / ton threshold, but plants still targeted by EPA
  - Gas generation was already marginal as flue gas concentration 1/3 of coal

- Inflation, inflation, inflation
  - Projects now mostly “out of the money”

What Could Make a Difference?

- Congress adjusting the Production Tax Credit (PTC) values for inflation
  - 40% capital cost increase since 2022
  - New baseline and inclusion of carbon capture in adjustments
  - Potential for bipartisan support regardless of election

- Local and regional incentives
  - California Low Carbon Fuel Standard (LCFS) great example

- Treasury revising hydrogen guidance
  - Harris admin – trash published guidance and rewrite
  - Trump admin – very tough to make more restrictive than already done…

Chevron Deference

- Rule-making process versus Congressional legislative direction
  - EPA established regulations solely through rule-making process (e.g. Mercury)
  - Chevron Deference referenced less frequently in past decade

- Removed 6-year statue of limitation
  - Now only need to show harm within past 6 year

- Similar outcome to lawsuits regardless of election
  - Harris admin – courts will determine acceptable adjustments
  - Trump admin – settle lawsuits with “adjusted” rules

Hydrogen & Ammonia

Green H_2 and Green Ammonia Update

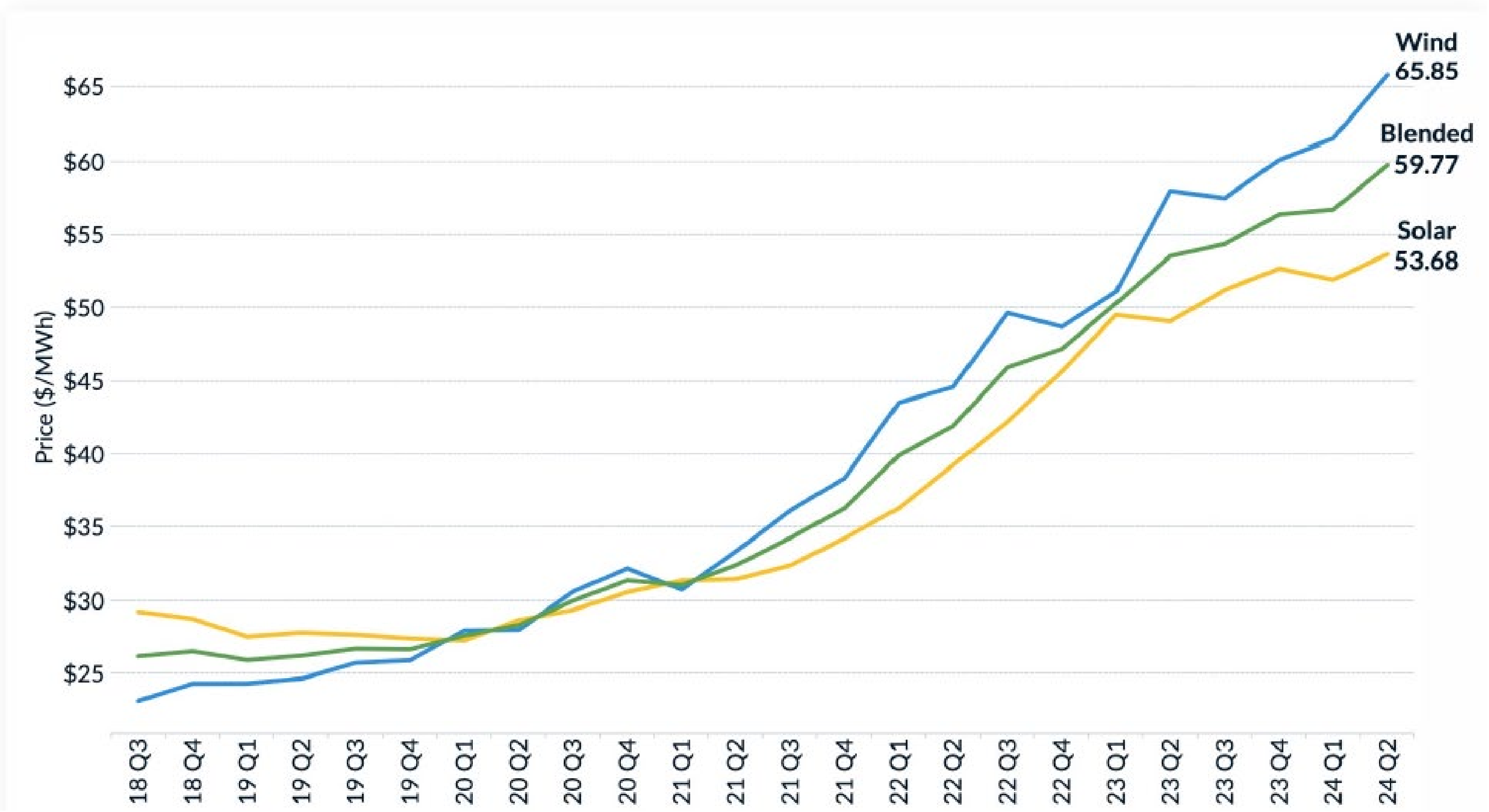
- Hundreds of announced mega-projects for "Green Hydrogen"
  - Many GW of power needed
  - Developers just "piled on" announcements without developing a viable pro forma

- Unreasonable power cost assumptions
  - 40-60% of "Green Hydrogen" production costs is power
  - Power costs used by DOE more indicative of a stranded asset
  - Competition for curtailed power not considered (e.g. transmission upgrades)
  - Treasury guidance delivered the "dagger to the heart"

H_2

NH_3

Renewable PPA Pricing



Source: https://go.leveltenenergy.com/l/816793/2024-07-15/39d8hg/816793/1721077080m3Z1pik8/2024Q2_NA_PPAPriceIndex_ES.pdf

BIG Winner thus far is "Blue Ammonia"!!!

- "Blue Hydrogen" to "Blue Ammonia" production
  - Natural gas SMR/ATR w/ carbon capture + Fischer Tropsch process
- Japan, Korea, Singapore
  - Seeing highly bankable long-term contracts
  - 20-year vision – extensive public/private collaboration
  - Alternative fuels cost substantially more, so reasonable choice
- E.U. expressing interest too
  - "Gaming" production method means less bankable contracts
- Minimal reliance on IRA of 2022 tax credits to continue

Carbon Capture & Storage

Breaking News…

ENERGYWIRE

ADM pauses Illinois carbon injection as it probes second leak

By Carlos Anchondo | 10/03/2024 06:41 AM EDT

Archer-Daniels-Midland sent EPA a letter about the conditions it is monitoring deep underground.

An Archer-Daniels-Midland plant is seen in Decatur, Illinois. PR Newswire

Elements of Successful CCUS Project

Capture Facility

+

CO_2 Pipeline

+

Sequestration

Geological or Enhanced Oil Recovery

Capture Facility

- Flue gas carbon capture technology has been proven at near scale
  - Petro Nova facility in Texas (suspended operations for several years based on economics)

- Industrial process facilities well proven
  - Ethanol
  - Steam Methane Reformer / Autothermal Reformer
  - Gasification

Source: U.S. DOE

CO_2 Pipeline Challenge

- Permitting, permitting, permitting
  - Stakeholder support challenged even in Midwest (Iowa)

- Environmental community
  - ADM leak issue SURE to have negative impact
  - Still involves burning of a fossil fuel
  - Methane emissions during production and transport of natural gas

Class VI CO_2 injection well permitting

- EPA was marching forward with state Class VI programs
  - Primacy granted to North Dakota, Wyoming, and Louisiana
  - West Virginia, Texas, New Mexico, others were in process
- Permitting durations
  - North Dakota achieved 8 months
  - Wyoming achieved 12 months
  - Federal EPA was targeting reduction to 24 months
- Primacy coupled with new laws by state legislatures
  - Accepting state liability and/or ownership (after 10 years) of sequestered CO_2
  - Protecting state revenue from oil and gas development

Regionally???

EPA NSPS Requirements for New NGCC

- New Source Performance Standard (NSPS)
  - Applicable for new fossil generation
  - EPA delayed existing unit requirements till 2025
- Natural Gas Combined Cycle (NGCC)
  - If >40% capacity factor, then Carbon Capture & Sequestration required
  - $2B in control equipment on a $1.3B natural gas combined cycle plant
- Lawsuits in process
  - Edison Electric Institute (EEI) challenging after supporting prior Clean Power Plan
  - Decision imminent on Supreme Court stay ruling
  - Much tougher for EPA to argue CCUS is “adequately demonstrated” for entire country

What are likely outcomes from ADM event?

- Federal EPA likely to pause issuing state primacy and Class VI permits
  - Material requirement for monitoring wells already recently changed
  - Time period for review and analysis (6+ months)
- Environmental groups will challenge existing Class VI permits
- North Dakota, Wyoming and Louisiana will continue to march forward
  - Already fully experienced with oil and gas type of risks
  - EOR likely to gain favor again
- Potential for negative perception of Direct Air Capture (DAC) technologies
- Stranded asset risk for investors

Future for Syngas

Blue Syngas Future is ~~Bright~~ Unknown

- "Blue" Hydrogen / Ammonia was **clear** winner over "Green"
  - Class VI well permitting facilitates this future
  - "Perfect" not achievable, marching back to "Good"

- Big RNG focus until fuel supply all used up
  - Primarily animal waste digesters

- Potential for negative carbon production processes
  - Capture + reduced carbon feedstock = <0
  - Competition for Direct Air Capture (DAC)?

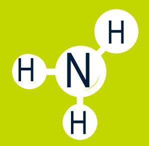
Political Future of Syngas

- Harris Administration
  - Continue pushing out IIJA DOE monies to “new” recipients
  - Need to redirect monies to fix financial viability of SAF projects
  - Continued misunderstanding by DOE of how private investment decisions are made
    - Exception is DOE Loan Program Office
  - EPA NSPS CCS requirement will need to be reconsidered

- Trump Administration
  - State and local incentives in absence of federal market driver
  - Any “redirected” IIJA monies likely to benefit syngas production methods
  - Unlikely to entirely undermine IRA of 2022 Production Tax Credits

Summary

IIJA and IRA Impact Challenged by Inflation



Hydrogen Challenged, but Ammonia Emerging as Winner

Regional Carbon Capture & Storage May Proceed

Future of Syngas is Unknown

Q&A

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