

# Navigating Today's Green Hydrogen Market: An EPC's Perspective

Global Syngas Technology Conference  
October 8, 2024



# S&B Overview

Consider It Done®



- Established in 1967
- Multi-discipline in-house engineering
  - **1,800 Home Office Staff**
- Full-service procurement
- Direct-hire construction
  - **Avg. 3,000-6,000 direct craft**
- Early FEL through EPC
  - **Single Source Solution**
- Early project engagement

**SAFETY**  
0.22 TRIR (2023)  
0.20 TRIR (2017-21 Avg)

**BUDGET**  
97% of EPC projects  
on budget since 2010

**SCHEDULE**  
90% of EPC projects on  
schedule since 2010

Refining



Hydrogen & Derivatives



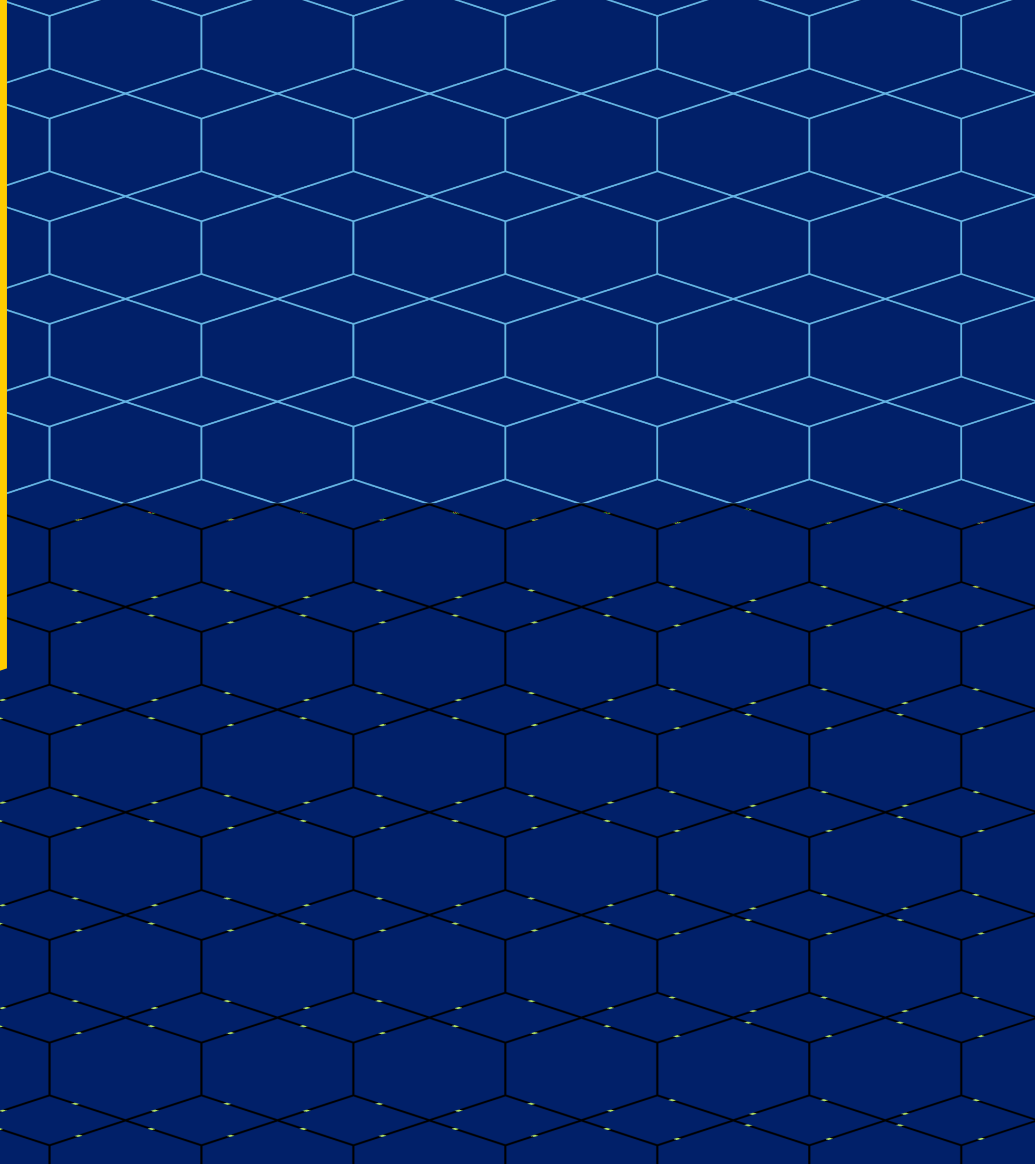
Chemicals



NGL Export Terminals



# **EARLY TECHNOLOGY SELECTION**





# GREEN HYDROGEN TECHNOLOGY

*Alkaline, PEM & SOEC are main commercial electrolysis technologies today, but new tech is emerging.*

## First wave electrolyzers (ELX):

- Established companies/Proven at commercial scale
- Financeable by debit entities
- Giga manufacturing capacity established

## Second wave electrolyzers (ELX):

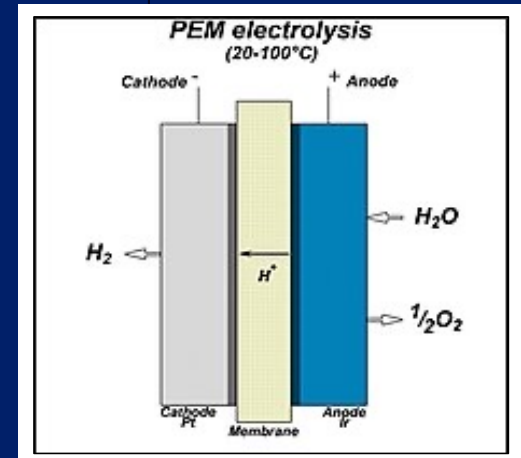
- Not commercialized at scale, delayed 1-2 years
- Manufacturing capacity concerns to meet large orders

## Containerized vs Building Enclosures:

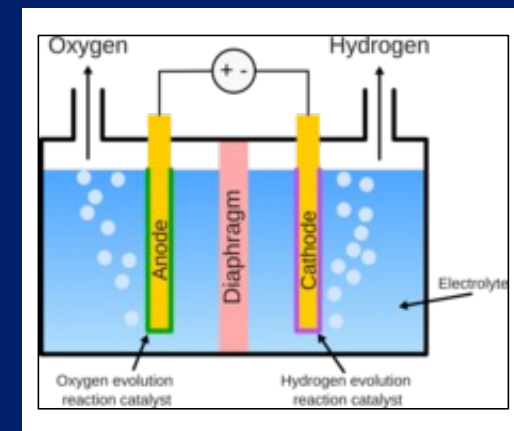
- CapEx Impacts when considering either options

## Utility tied or behind the meter applications:

- Turndown and cyclical considerations needed when evaluating PEM vs Alkaline electrolyzer options



PEM Electrolyzers



Alkaline Electrolyzers

# PEM vs.

## ALKALINE KEY CONSIDERATIONS



- **Electrolyzer efficiency:** Power consumption for PEM is slightly more efficient ~5 kWh per kg less than Alkaline
- **Outlet discharge pressure:** PEM has a nominal hydrogen gas pressure of < 30 bar (~400 psi) while Alkaline can range from atmospheric to 15 bar. Additional compression may be needed depending on application, means increased CAPEX.
- **Life cycle cost:** Ease of maintenance and membrane change out frequency, PEM membranes are more expensive than Alkaline due to rare earth metals needed.
- **Supplier shop capacity and delivery schedule:** First wave ELX has advantage, but this will diminish over time as new capacity come online.

# PEM vs. ALKALINE CONTINUED..



- **Equipment delivery method:** Modularized vs. individual components to be installed in the field.
- **Plot considerations:** Alkaline larger space requirements for same production. PEM is more suited for containerized options.
- **Cell Stack Life:** Alkaline Cell Stack Life 7 years +/-, PEM is 3 years +/- . Dynamic power supply can shorten the stack life as well.
- **Turndown capacities:** Alkaline can turndown to ~10-25% capacity with hot standby mode, and PEM doesn't have these issues.
- **Cyclical Operations:** Studies have shown PEM is better suited to dynamic power supply operations where hydrogen output fluctuates.

# PROJECT ECONOMICS



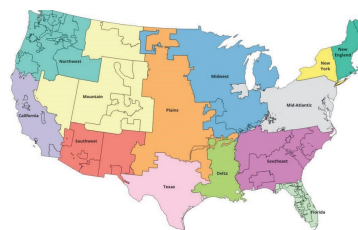
# 45V PTC Tax Credit Regulations

Proposed “three pillars” are subject to finalization from the Treasury Department by EOY 2024



## Time Matching

- Starting in 2028, green hydrogen production must be matched to renewable power production on an **hourly** basis
- Wind and solar generation varies greatly – i.e., not windy or sunny at all times
- REC market is primarily annual now – will need to evolve to hourly
- Developers considering strategies such as hydrogen storage, power storage (batteries), and/or lower electrolyzer capacity factors



## Deliverability

- Power production for green hydrogen must be from **same “region”** as the hydrogen production
- New definition of “region” embraced by IRS for purposes of 45V – (map above)
- Some regions will be more favored than others, depending on solar/wind resource available, industrial hydrogen demand, and other factors.
  - Texas – ammonia/methanol and proximity to nearby export markets
  - Arizona – H2 liquefaction and transport to California



## Incrementality

- Green hydrogen must be produced using electricity from a **“new” power source**
- “New” defined as less than 36 months older than the hydrogen facility
- May impact speed of green hydrogen rollout due to timing issues with renewable power interconnection and permitting
- Particularly impactful for green hydrogen projects planning to use nuclear or hydroelectric power



# Contractor Compliance with 45V

*Major impacts to qualify for full tax credits*



## Apprenticeship

- Administrative costs for company-wide program
- Increase in total manhours
  - ✓ 15% of Total Field Labor Hours
  - ✓ Including Construction Subcontractors
- Minimized productivity from apprentices while in the field
- Additional training personnel, tools, and facilities

## Prevailing Wages

- Prevailing wages + **Fringe Benefits**
  - **Will require Asset Owner's assistance to get wage variants**
  - **More clarification is needed to understand if Contractor provided benefits can be offered / accepted to reduce the fringe benefits cost.**
    - ✓ **In some areas the value is up to 100% of the prevailing wage**
- Increased accounting and bookkeeping personnel
- Increased legal and administrative support
- Lack of standardized/consistent job classifications

# CONTRACTOR COMPLIANCE WITH 45V



## Project Risk Increases

- Out-of-compliance activities
- Increased labor force
- Evolving interpretation of rules

## Capex Increases

- Additional labor/administration hours
- Possible productivity impacts
- Increased project risks

## Requirement Uncertainty

- Interpretation of Direct Labor hours
- “Good faith efforts”
- Job classifications/Fringe Benefits

# EPC Engagement



# Mitigate Risk by Engaging the EPC Early



- Project stakeholder alignment (Project's Goals)
- Selection of technology and key equipment suppliers
- Project economic analysis, levelized cost assessments
- Front end loading, pre-FID design
- Risk assessment & mitigation
- Design with the end in mind (Early Constructability Reviews)
- Early EPC estimate & schedule validation



Technology Selection



Early EPC Estimates / Schedules



Project Economics



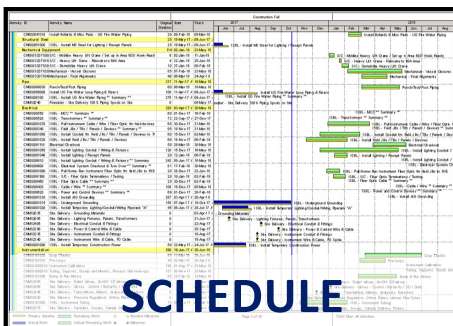
# Minimizing Risks Early

Strategies for early EPC engagement to mitigate risks



- Select technology licensors and key equipment suppliers early
- Assess site conditions, utility availability and water supply / quality
- Interface Management: Clearly define scope split between the owner, technology licensor, EPC, and third parties

## Mitigation



- Establish lead times for key equipment early in FEL, continued supply chain concerns around LLE
- Identify key permitting requirements and prioritize needed info in FEL
- Begin with realistic target schedule and refine throughout FEL



- Produce budgetary cost estimates at key decision points in FEL
- Allocate each risk to the party best positioned to manage it (e.g., early discussion on EPC terms sheet)
- Understand 45V tax credit requirements and implications on cost (e.g., prevailing wage & apprenticeship)



# Alternative Execution Approach

Industry moving away from LSTK to a **hybrid EPC execution models**

## Project Execution Risk

- **Technology:**

- Electrolyzer OEM's development and capability to supply at scale;
- New technology risk with proprietary equipment;

- **Long-Lead Equipment:** Continued price and schedule escalation around key items

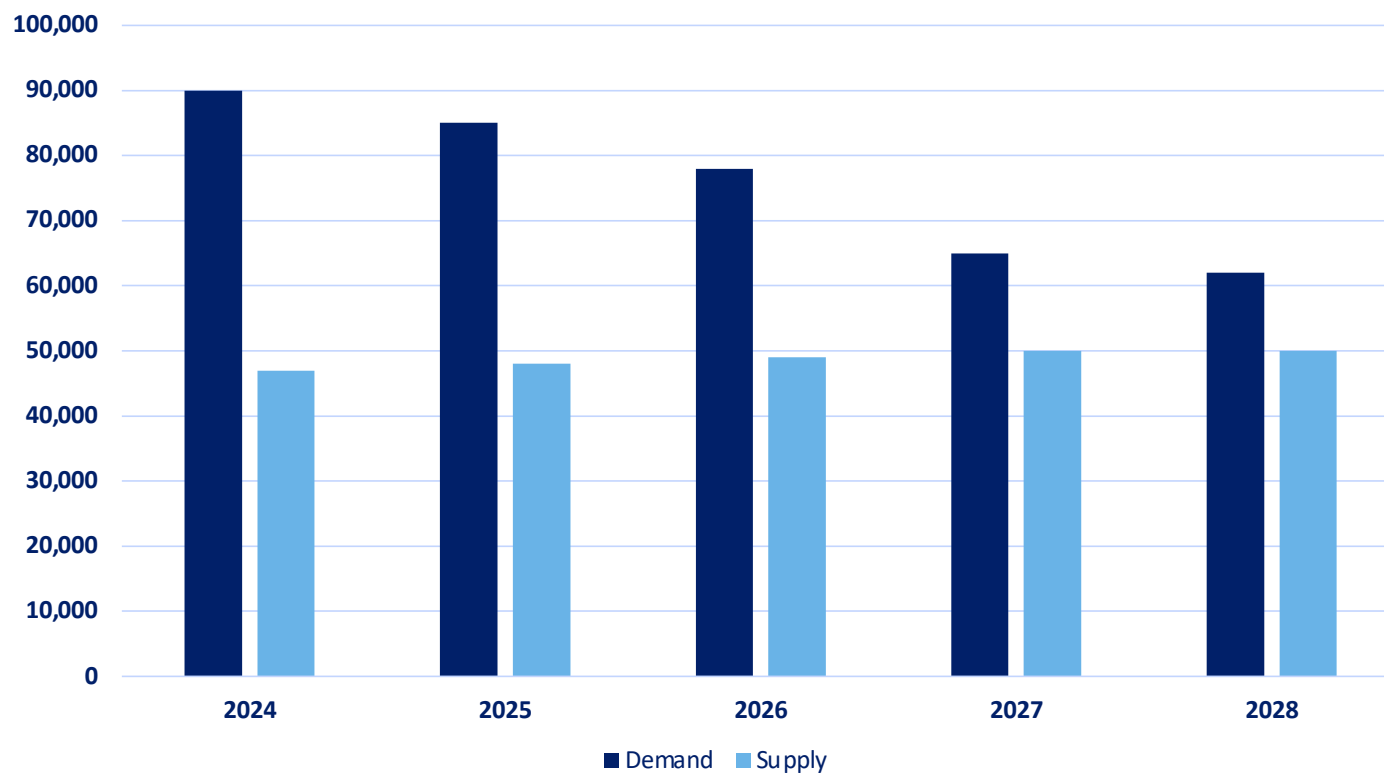
- High & Medium Voltage Transformers, Rectifiers, PDC & Liquefied Storage Options

- **Labor Availability:** 2025-2029 will represent more capital projects than available craft labor to execute them

- **IRA Compliance:** Ability to receive maximum tax incentives



# USGC Craft Labor Demand



S&B analysis derived from IIR (source)



# COST REIMBURSABLE TO LUMP SUM CONVERSION

**Converted to lump sum as project matures – reduces escalation costs**

- Engineering
- Procurement (Equipment & Bulks)
- Fabrication
- Construction Management/Indirects

**Cost reimbursable portions of the project**

- Site Prep
- Construction Labor
  - Including Apprenticeship Program
- Commissioning & Startup
- Performance Testing

# S&B Can Help



- Significant experience in green hydrogen projects
- Early selection of technology and key equipment is critical
- Engage the EPC early to mitigate risks
- Conceptual estimates based on completed projects
- Creative contractual approach to EPC execution





CONSIDER IT DONE.

# THANK YOU

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