How the Clean Hydrogen Production Tax Credit Will Affect Electrolyzer Growth and Flexibility

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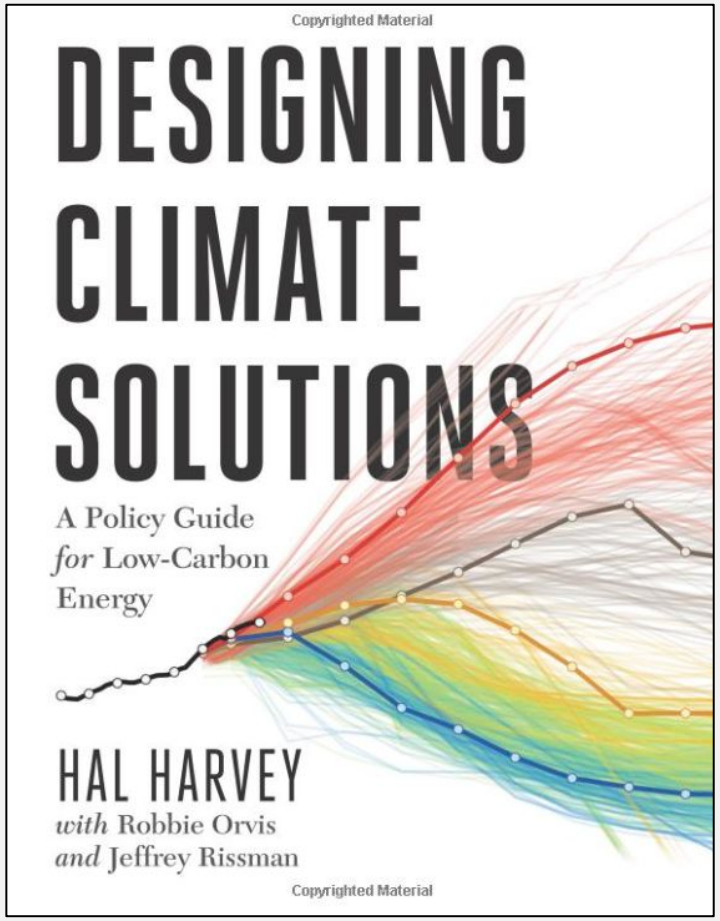
ENERGY INNOVATION
POLICY & TECHNOLOGY LLC

Energy Innovation

- Non-partisan climate policy think tank working with policymakers regardless of political affiliation
- We provide objective research based on scientific assessments to identify **the most effective economywide emissions reduction policies**



Agenda

- Hydrogen Basics
- Clean Hydrogen Production Tax Credit (“45V”)
- Loose Guidance
- Stringent Guidance
- Summary

Fossil-Based Hydrogen Production

methane (CH_4)

heat*

*from burning more methane

carbon dioxide (CO_2)

hydrogen (H_2)

Produces ~10 $kgCO_2e$ / kgH_2

Electricity-Based Hydrogen Production

water (H_2O)

electricity

oxygen (O_2)

hydrogen (H_2)

Produces ~0-50 $kgCO_2e$ / kgH_2

Hydrogen Uses

First Wave

- **Forklifts**
- **Refineries**
- **Transit buses**
- **Heavy machinery**
- **Ammonia**
- **Long-haul HDVs**

Second Wave

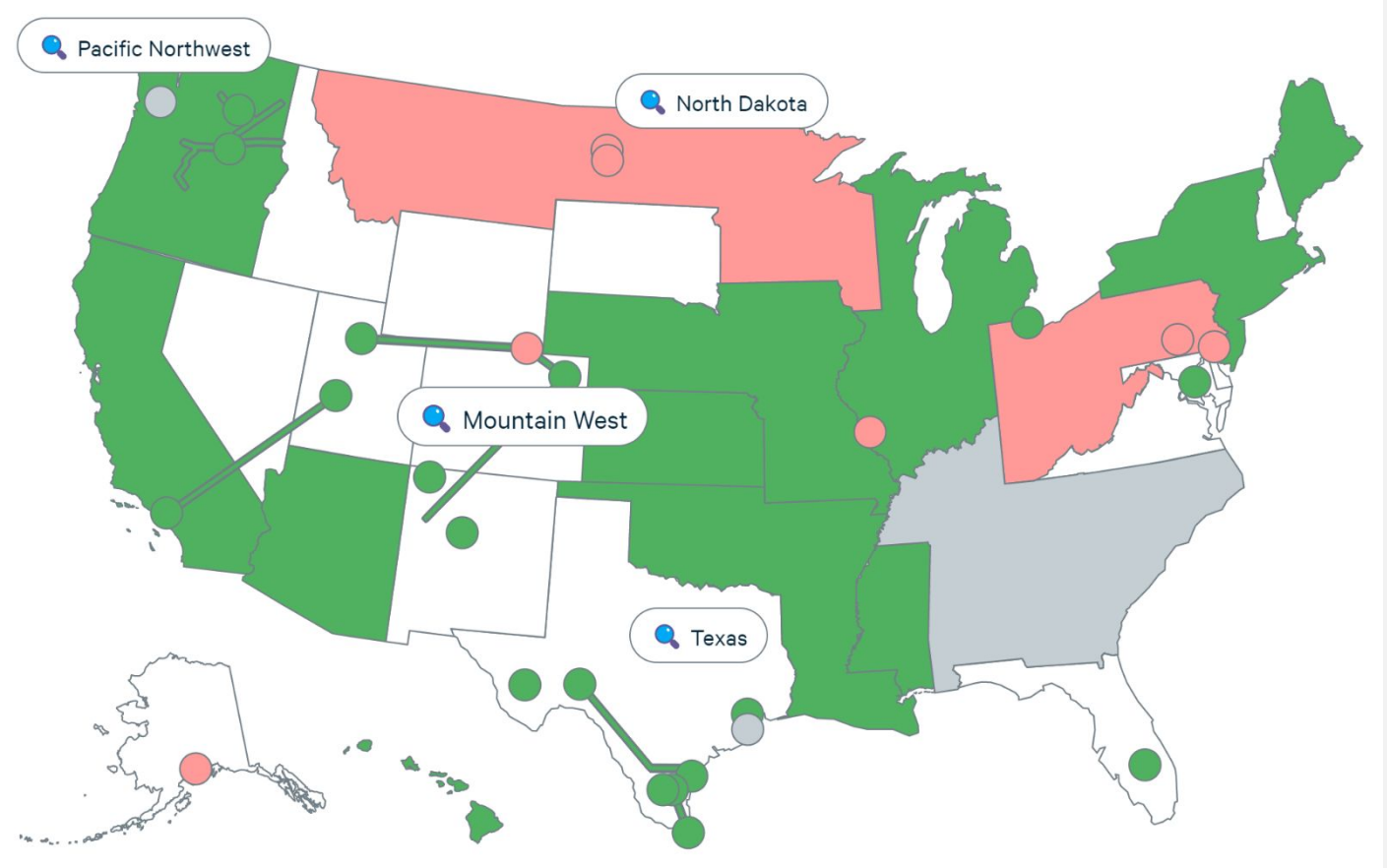
- **Chemicals**
- **Steel**
- **Energy storage**
- **Power gen**
- **Aviation**
- **MDVs**

Third Wave

- **Backup power**
- **Methanol**
- **Container ships**
- **Cement**
- **High-temp heat**

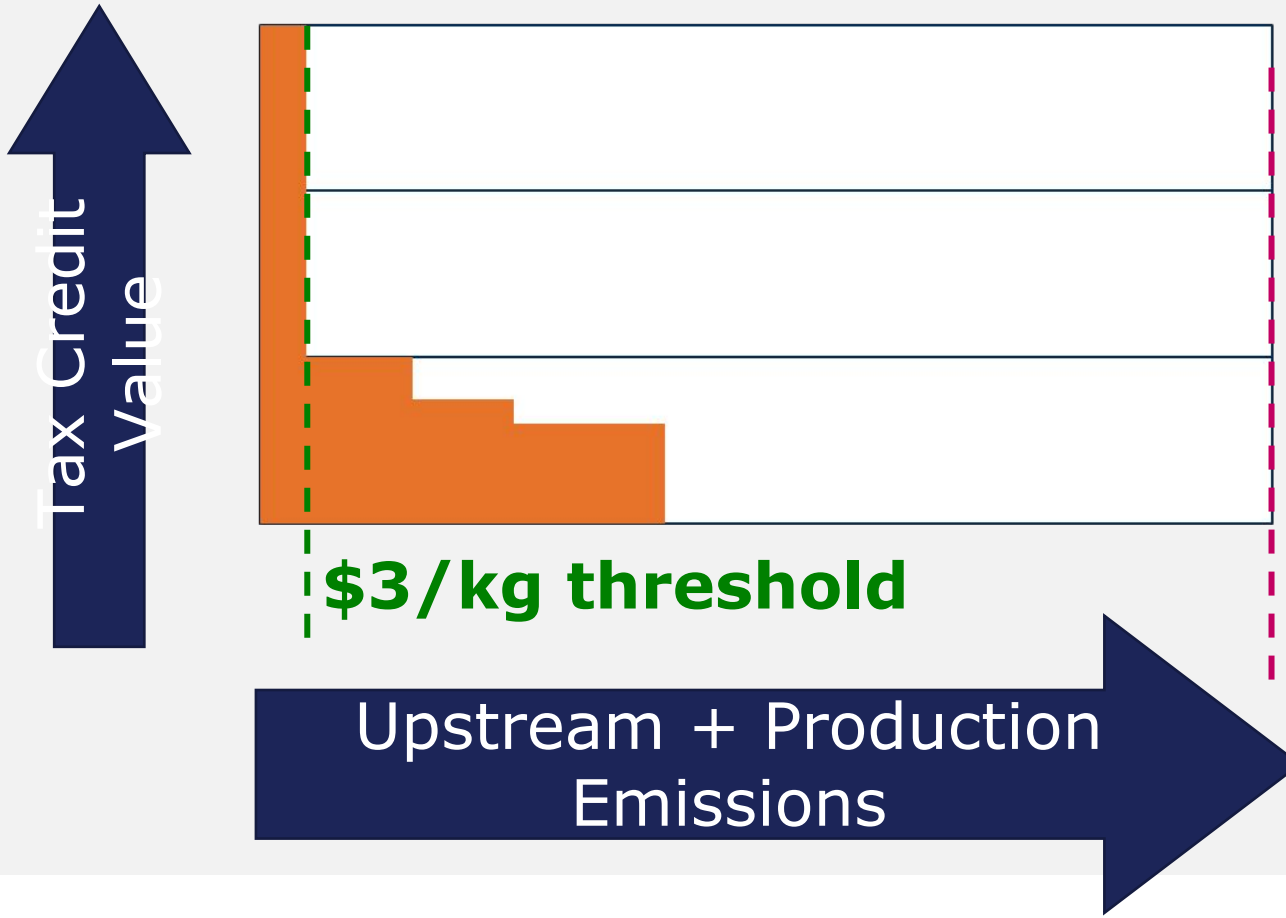
Source: https://www.hydrogen.energy.gov/pdfs/us-national-clean-hydrogen-strategy-roadmap.pdf

Clean Hydrogen Hubs (IIJA)



Source: https://www.rff.org/publications/data-tools/hydrogen-hub-explorer/

45V Clean H_2 Production Tax Credit (IRA)



$3/kg tax credit
+ $1/kg sale price
= ~$80/MWh value

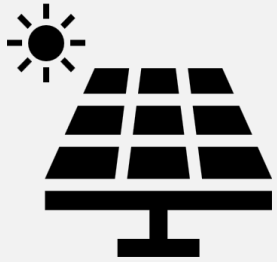
Load Growth Implications

2030	2040	2050
10 MMT H_2	20 MMT H_2	50 MMT H_2
500 TWh*	1,000 TWh*	2,500 TWh*

*Assumes H_2 supplied fully by best-in-class electrolyzers (50 kWh/kg)

https://www.hydrogen.energy.gov/pdfs/us-national-clean-hydrogen-strategy-roadmap.pdf

Pillars for Measuring Electrolyzer GHGs



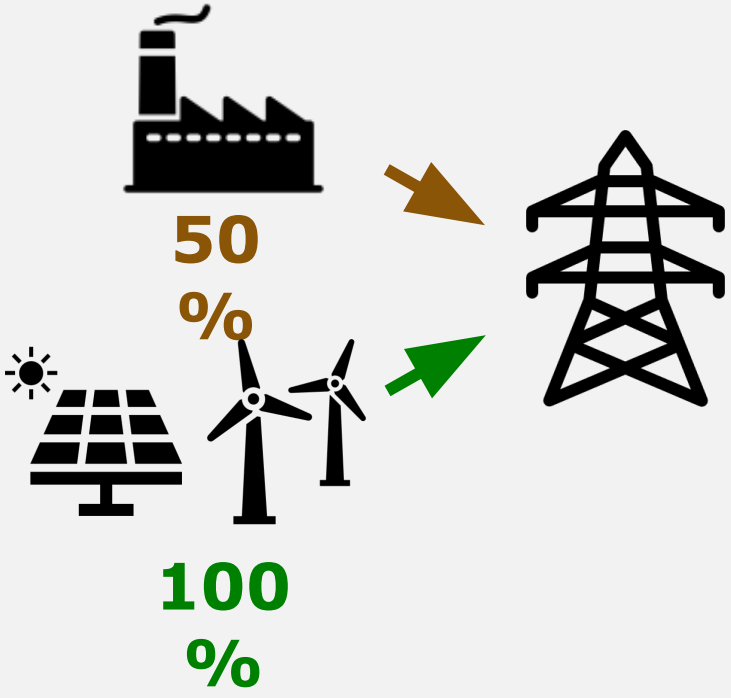
Additionality – use *new* sources of clean electricity

Deliverability – use *local* sources of clean electricity **+** account for transmission line losses

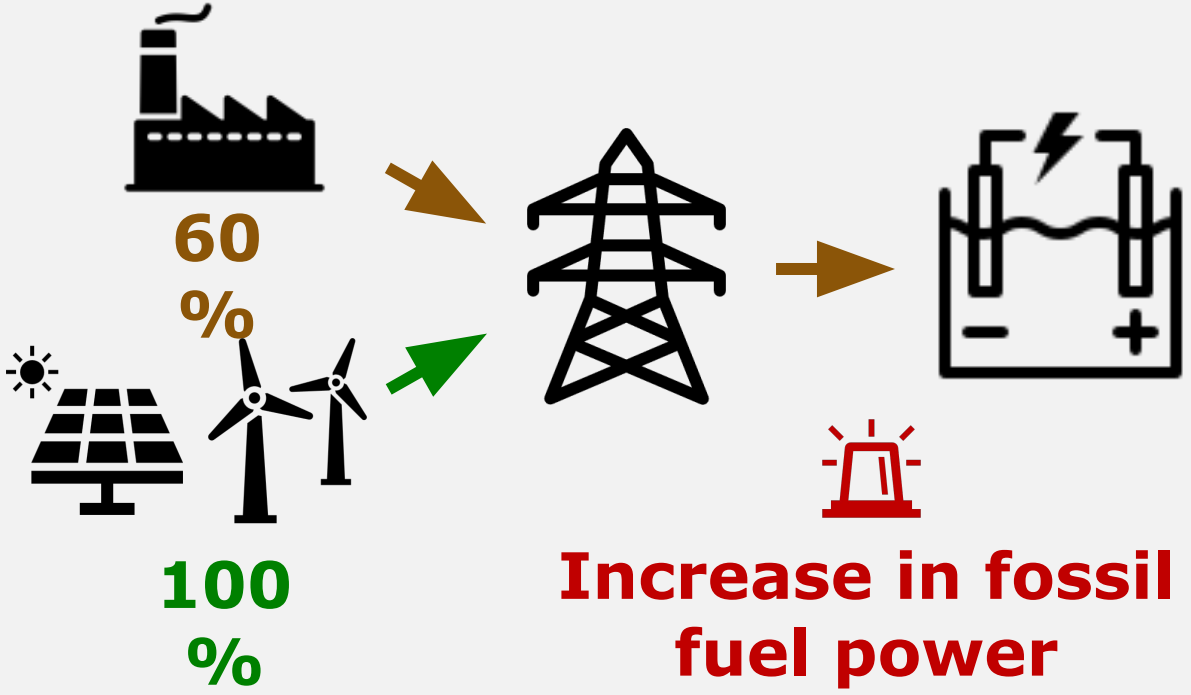
Time-matching – ensure electrolyzer runs at same time of clean electricity generation

Additionality – Overview

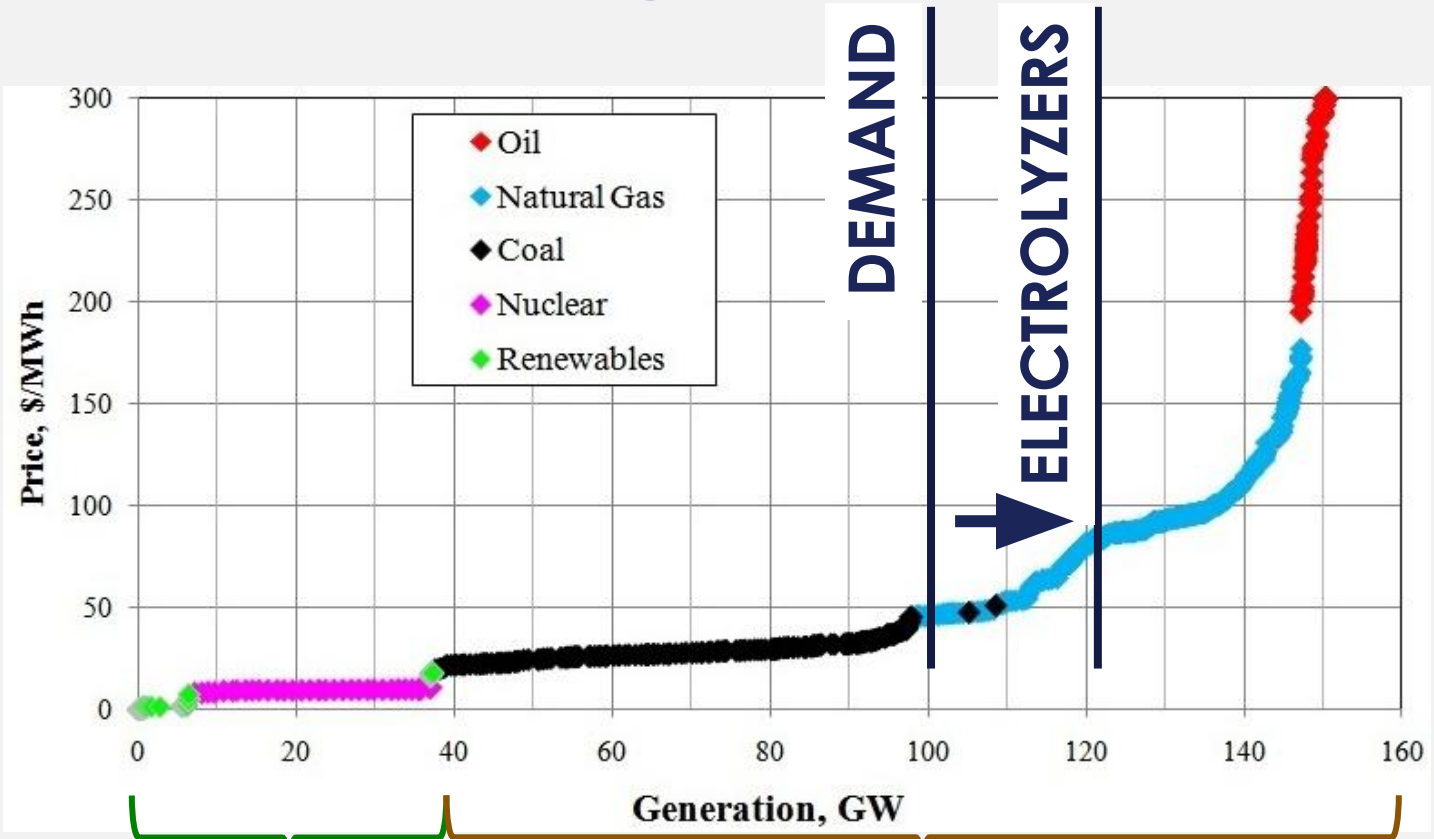
No Electrolyzer



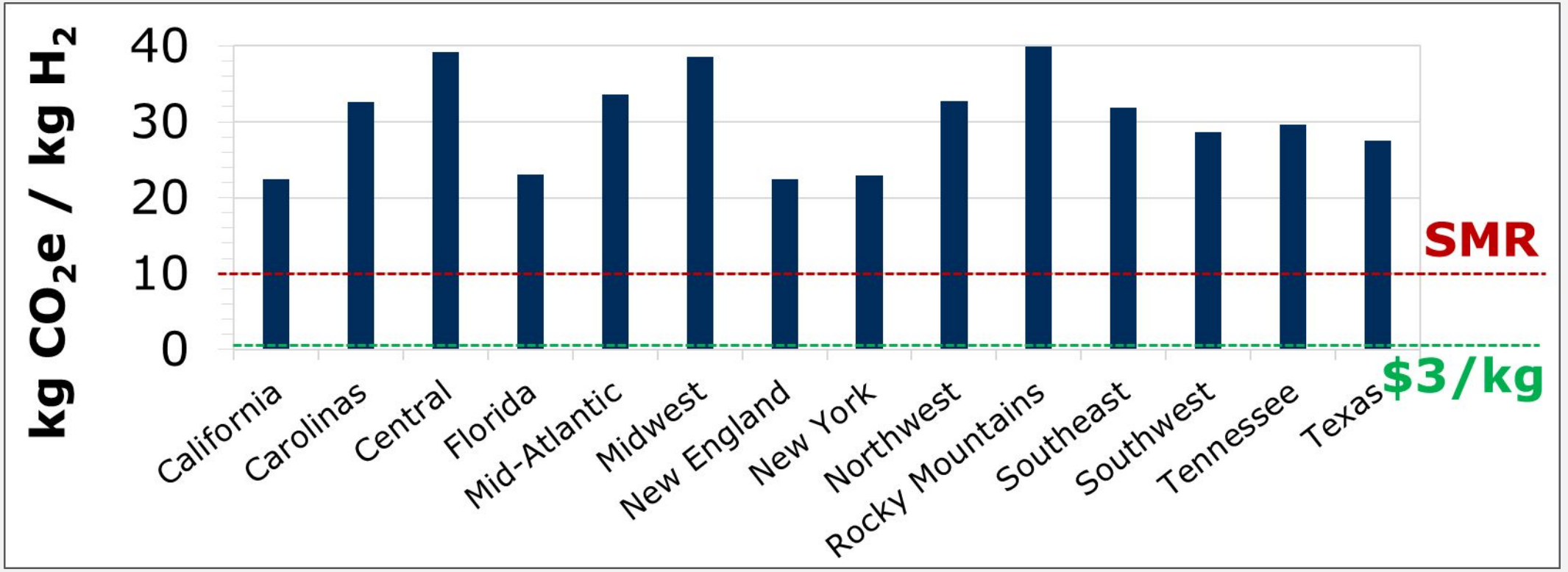
Dirty Electrolysis



Additionality – Marginal Demand

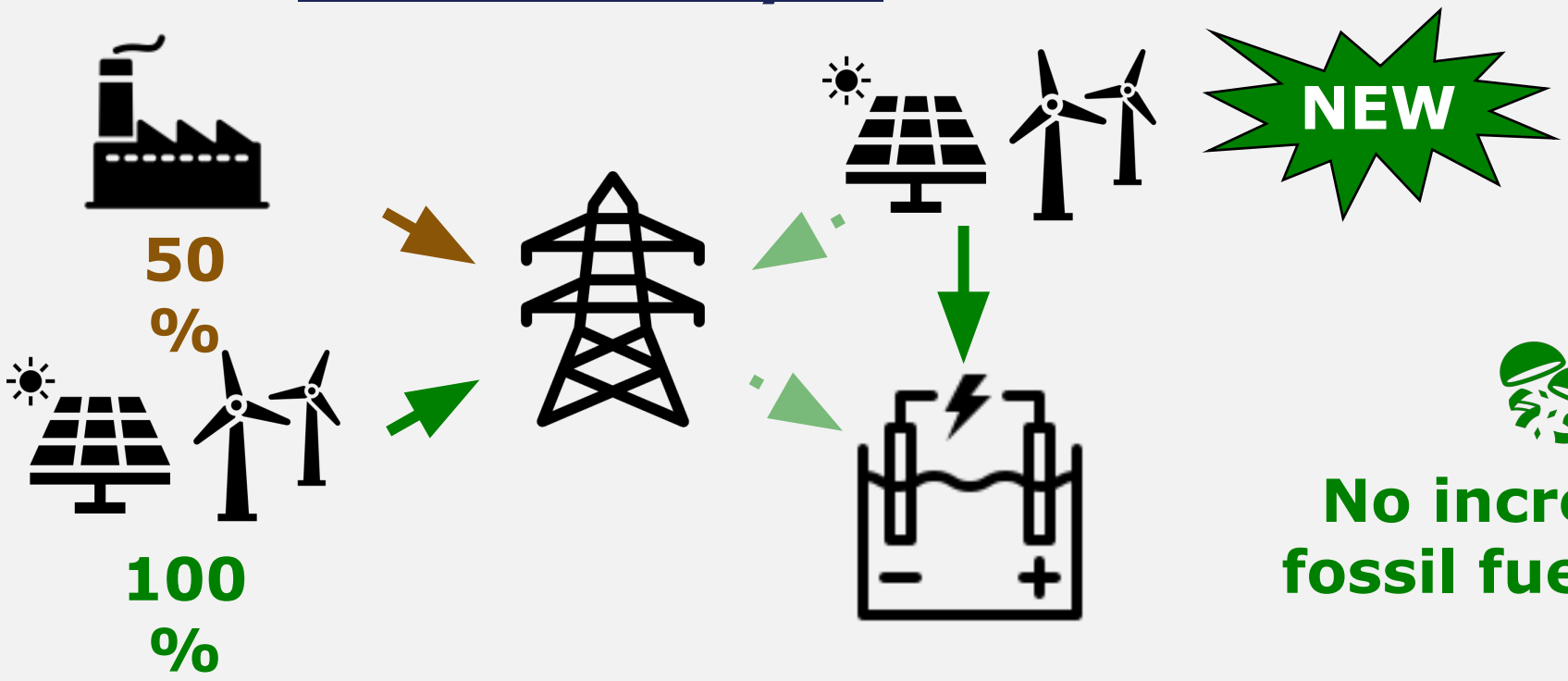


Additionality – Emissions Risk

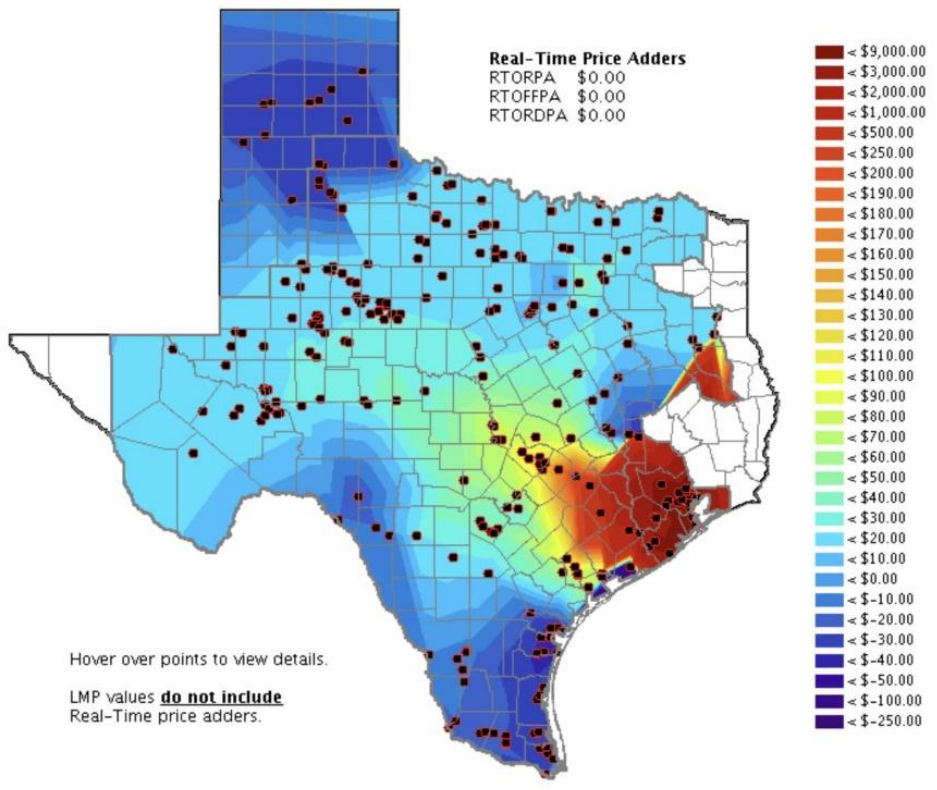


Additionality – Solution

Clean Electrolysis

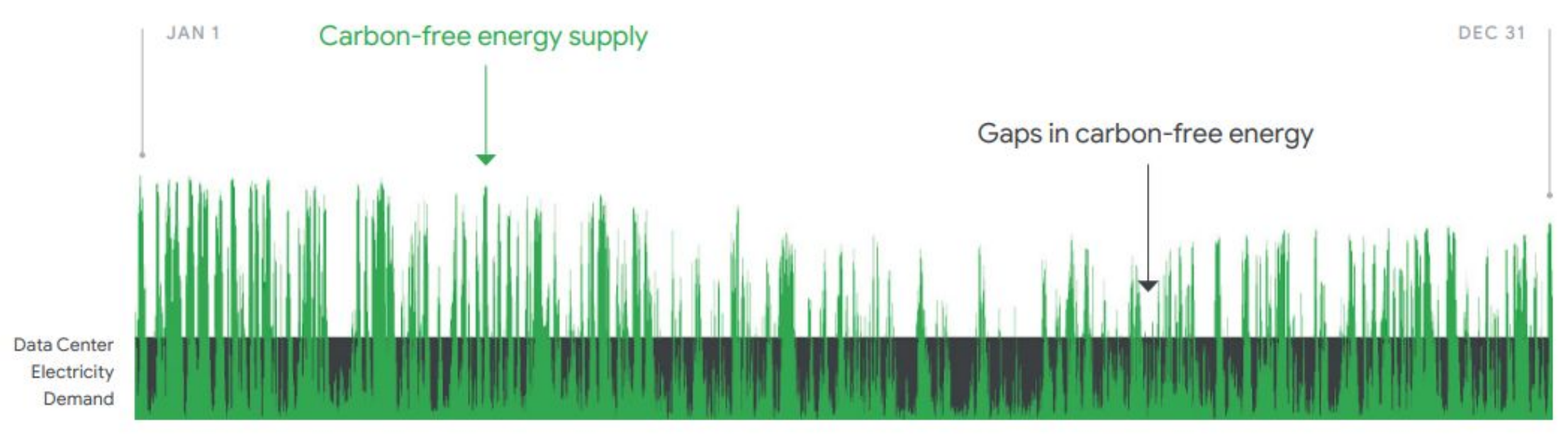


Deliverability



Emissions risk up to
~17 kgCO2/kgH2

Hourly Time-Matching

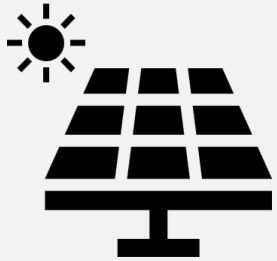


Short-run emissions risk is modest but >0.45 $kgCO_2/kgH_2$

Long-run emissions risk is >20$kgCO_2/kgH_2$

Source: https://clim8.com/wp-content/uploads/2020/11/247-carbon-free-energy12.pdf

Debate – What Standards to Set?



Additionality – axing it lets all existing nuclear qualify

Deliverability – axing it lets you build electrolyzers anywhere

Time-matching – axing it opens door to pure solar projects

Two Products For Implementation

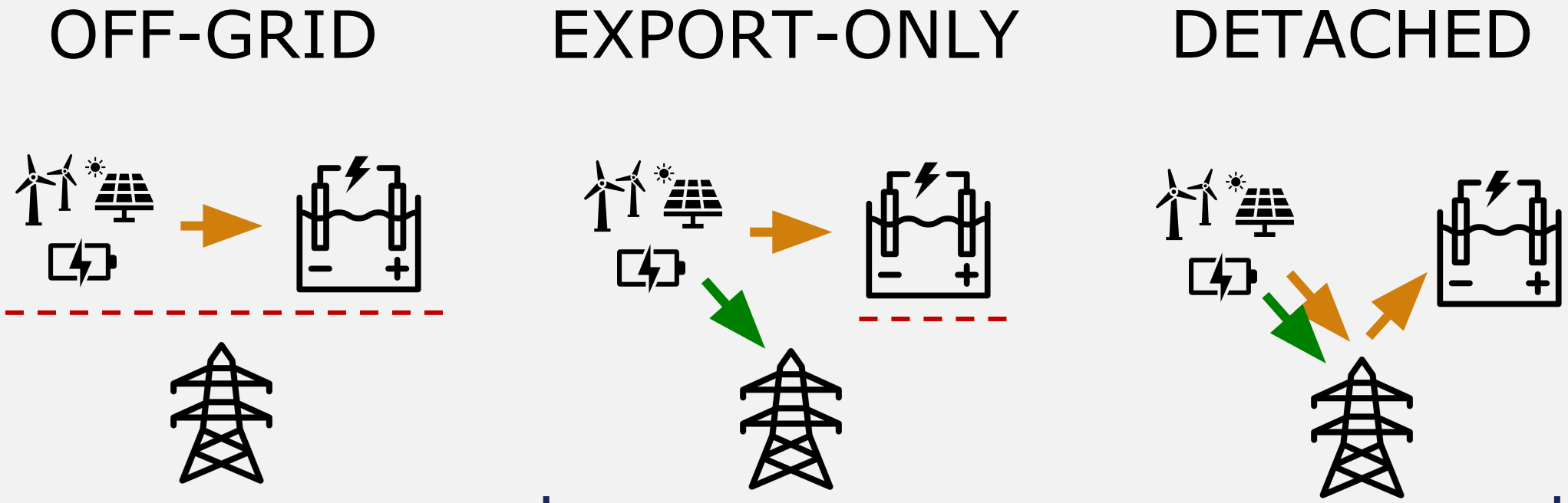
Power Purchase Agreement

- Signed within 2-3 years of new clean energy coming online
- 10+ years
- Provides evidence that electrolyzer was key to financing

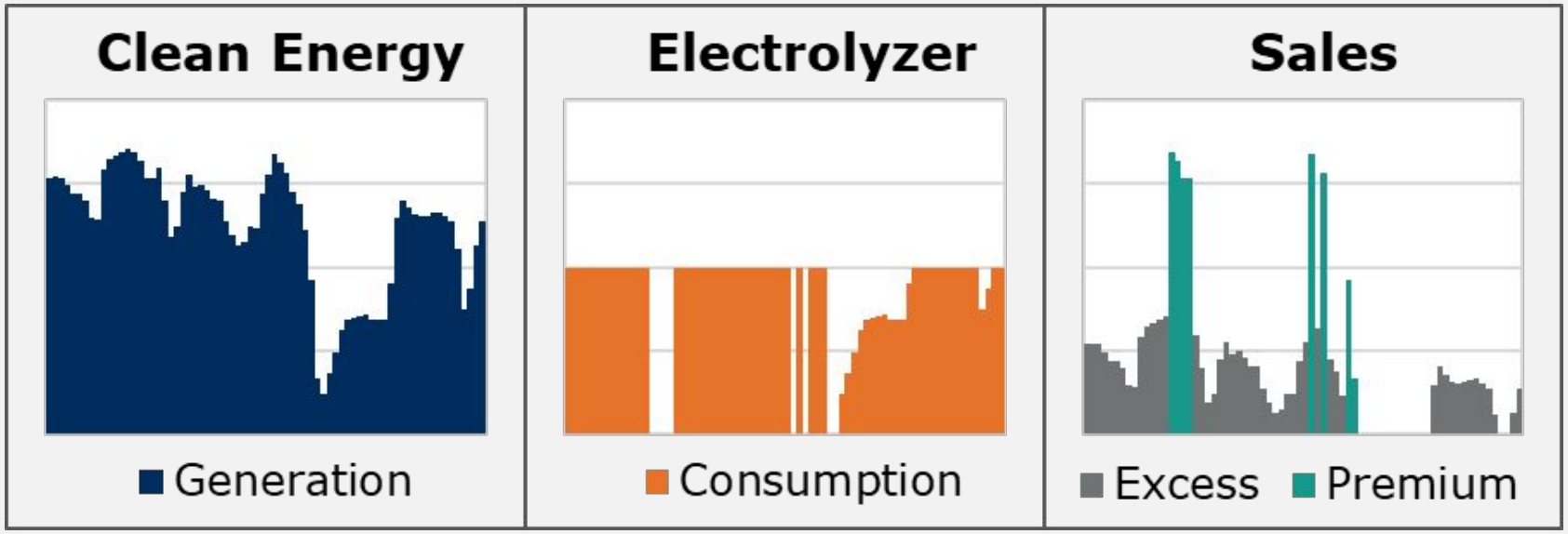
Hourly Clean Energy Credits

- Contain vintage, location, and time attributes
- Can be ready everywhere by 2026

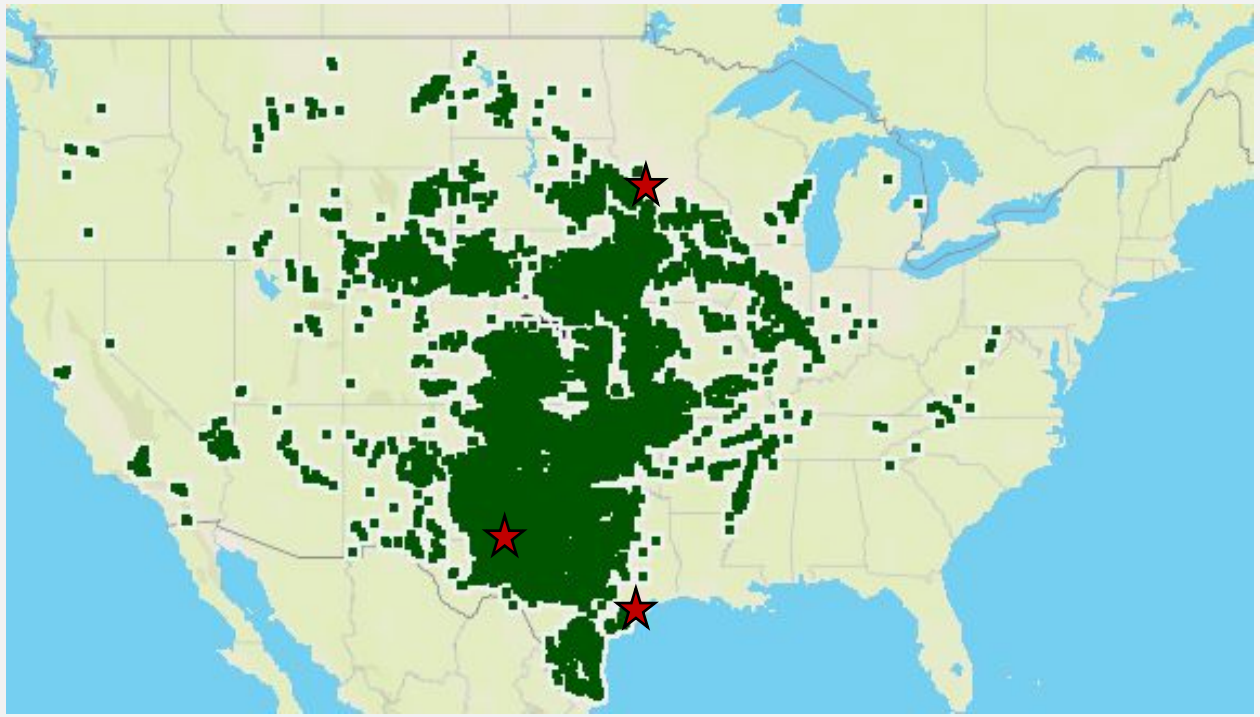
Types of Project Designs



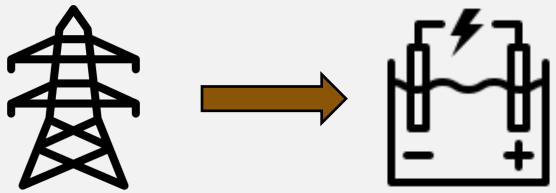
Grid-Connected Project Operations

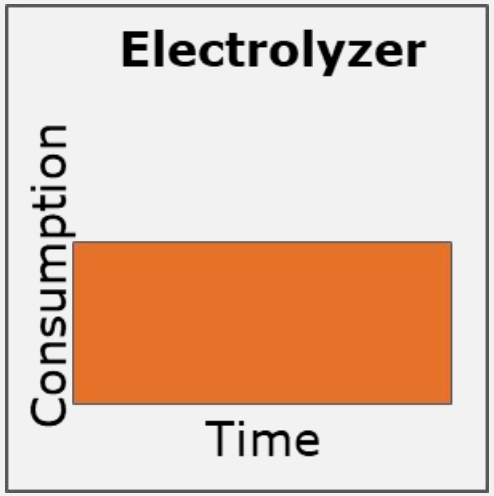


Export-Only Project Economics (Day 1)



Loose 45V Guidance – Overview



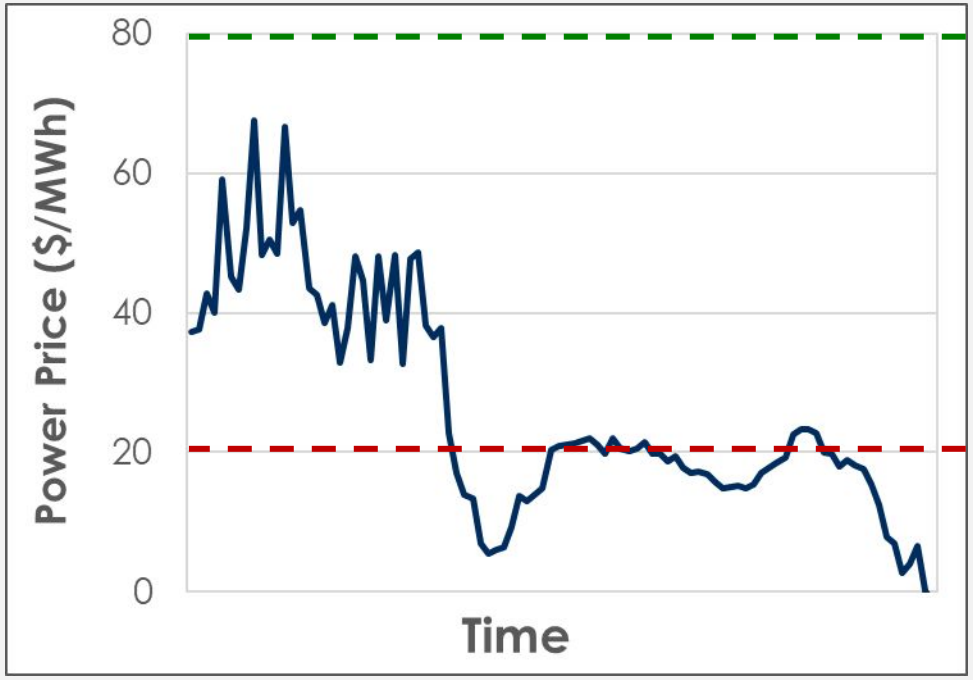


24/7 Run around the clock

Maximize gov’t subsidies

No need for H_2 storage

Loose 45V Guidance – Problem



With subsidy

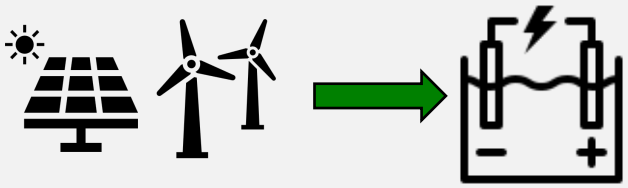
Without subsidy

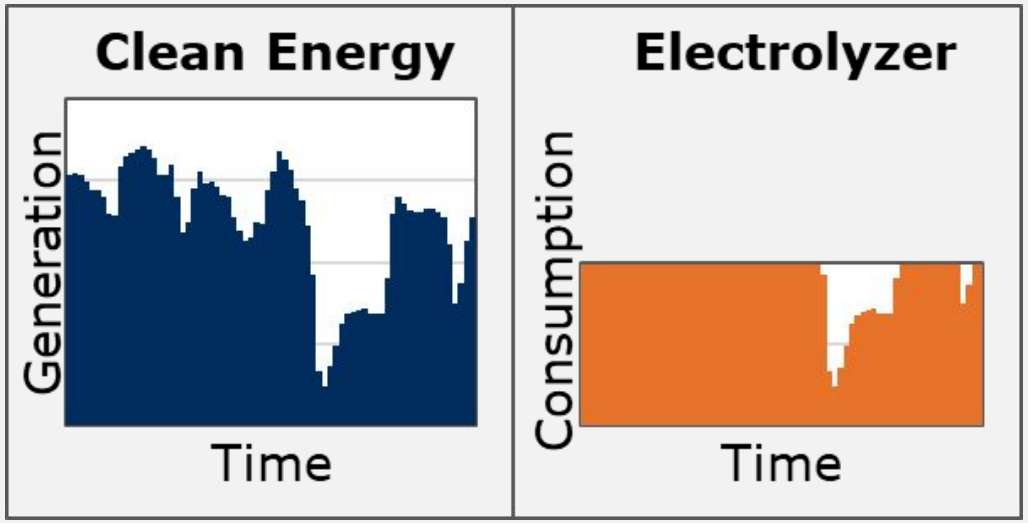
Loose 45V Guidance – Consequences

Option 1:
Stranded Assets
Lost Jobs
Derailed Industry

Option 2:
Subsidy Extension
More GHGs
More 24/7 Loads
Delayed Problem

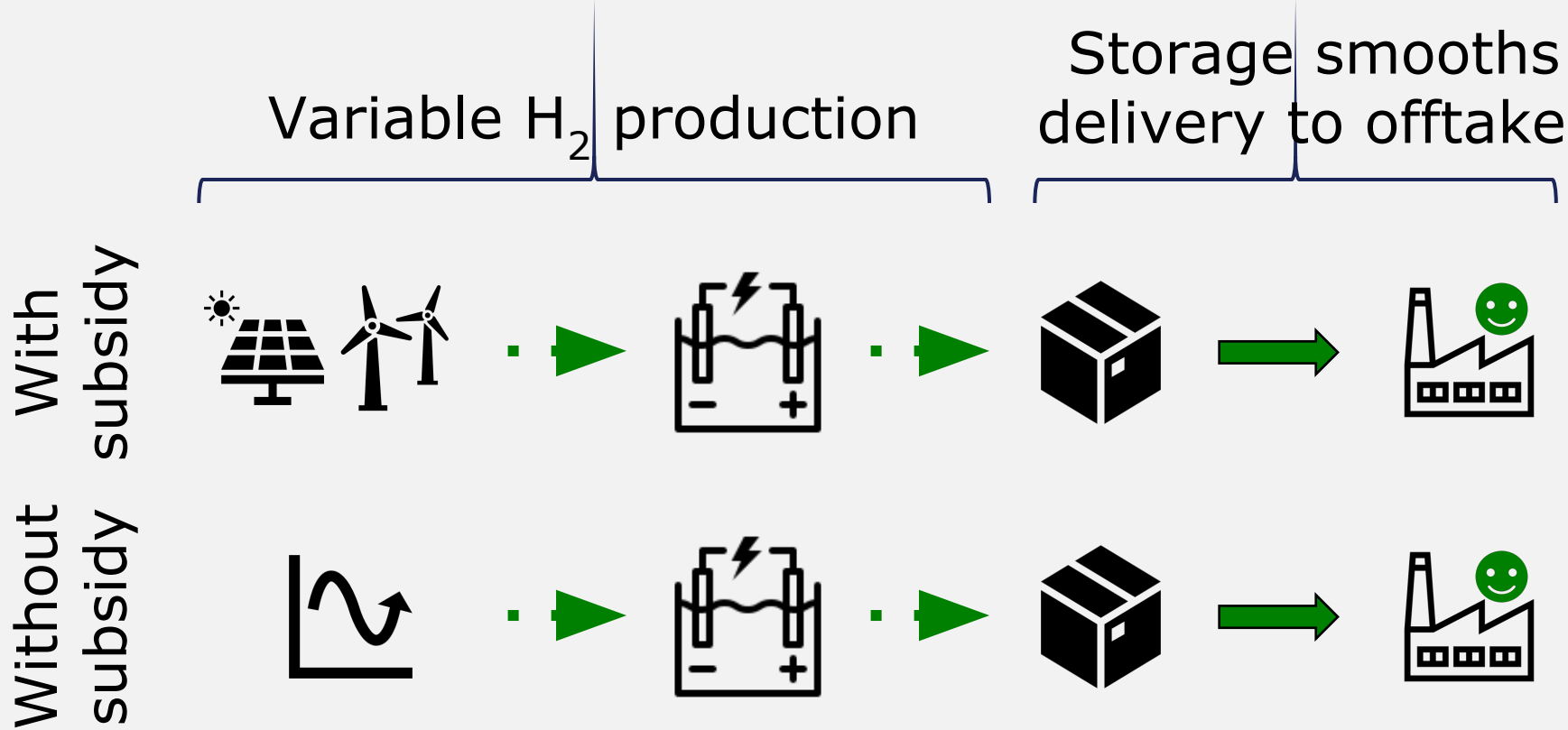
Stringent 45V Guidance – Overview



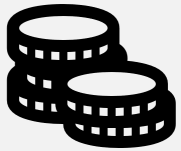


- Ramp up and down
- Fewer gov’t subsidies
- H_2 storage to firm output

Stringent 45V Guidance – Sustainability

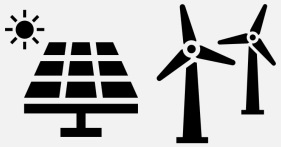


Stringent 45V Guidance – Grid Benefits



Very low or negative power prices

=



Excess renewables

=

Electrolyzer online

Higher power prices

=

Fossil power online

=

Electrolyzer offline

Summary

- **Loose guidance** = lots of inflexible (24/7) loads coming online, long-term uncertainty
- **Stringent guidance** = more renewables than loads come online, long-term flexibility benefit
- Many potential scenarios in between

Thank you

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SMART DESIGN OF 45V HYDROGEN PRODUCTION TAX CREDIT WILL REDUCE EMISSIONS AND GROW THE INDUSTRY

DAN ESPOSITO, ERIC GIMON, AND MIKE O'BOYLE

APRIL 2023[i]

EXECUTIVE SUMMARY

The United States cannot achieve net-zero greenhouse gas (GHG) emissions without carbon-free hydrogen. Today, this molecule serves the chemicals and refining industries, and fossil fuel-derived hydrogen production contributes about 1.5 percent of total U.S. climate pollution. Shifting to cleaner hydrogen production can replace these dirty sources while cutting GHG emissions in industries that are hard or impossible to electrify.

Congress included a production tax credit (PTC) for clean hydrogen in Section 45V of the Inflation Reduction Act (IRA) to help scale the nascent industry. The tax credit's value is tied to the lifecycle GHG emissions of hydrogen production—including upstream emissions—with the highest tranche set at $3 per kilogram (kg) of hydrogen that is nearly emissions free.

Congress tasked the U.S. Treasury Department with deciding how hydrogen producers must account for their emissions to qualify for these incentives. Treasury accepted public comments in December 2022 and is working on final rules at the time of this paper's publication.

This research shows loose 45V guidance could create tens to hundreds of millions of tons of GHG emissions annually at a cost of $30 billion annually in federal funding while setting the

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