



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

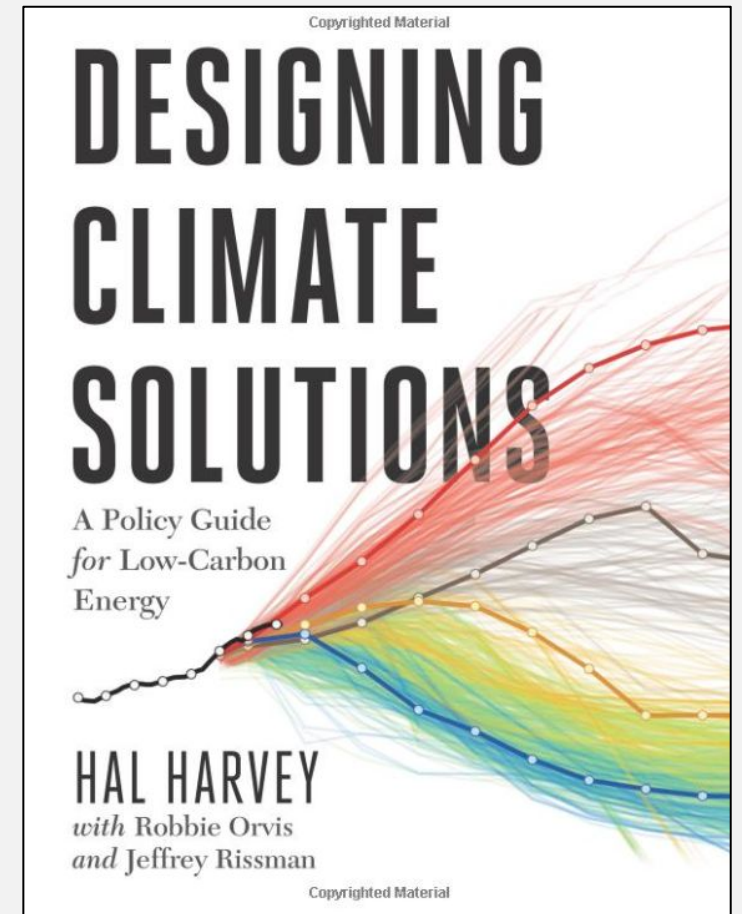
Dan Esposito
Senior Policy Analyst
June 2023

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**

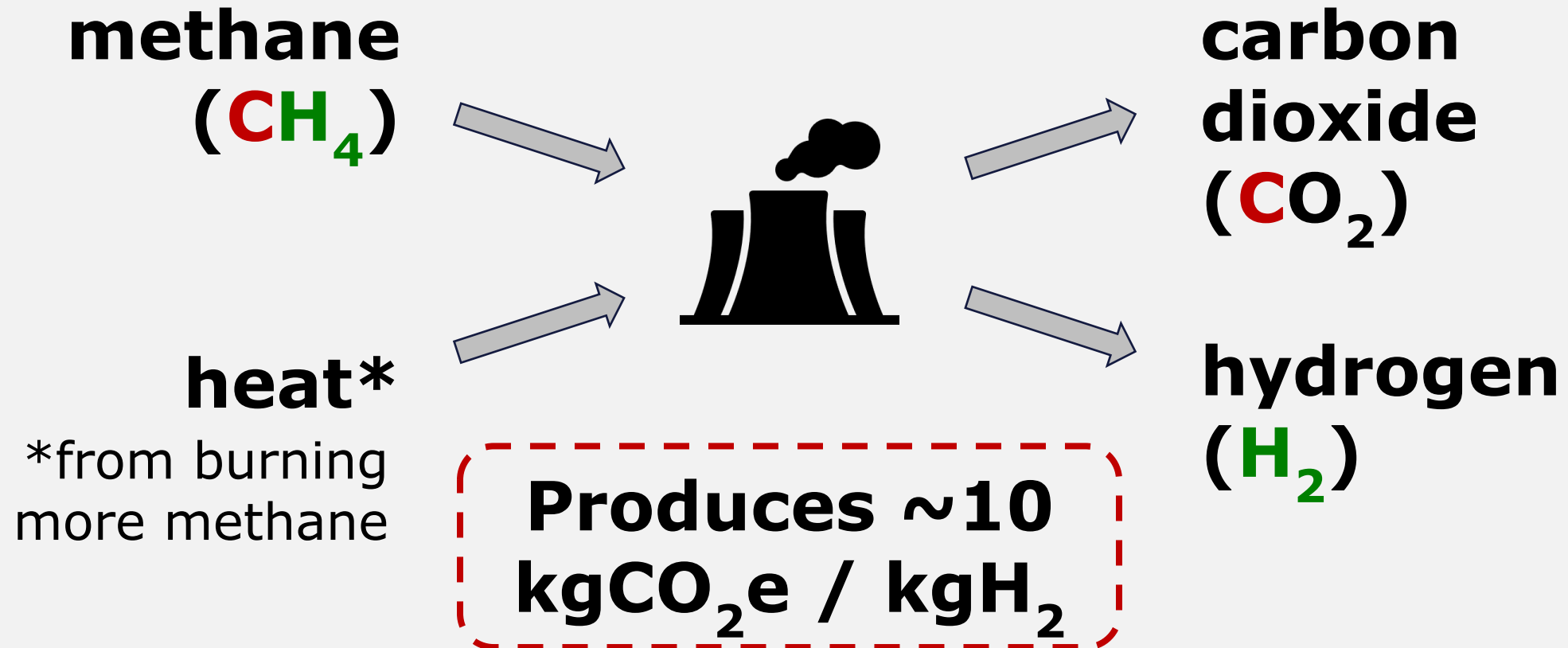


Agenda

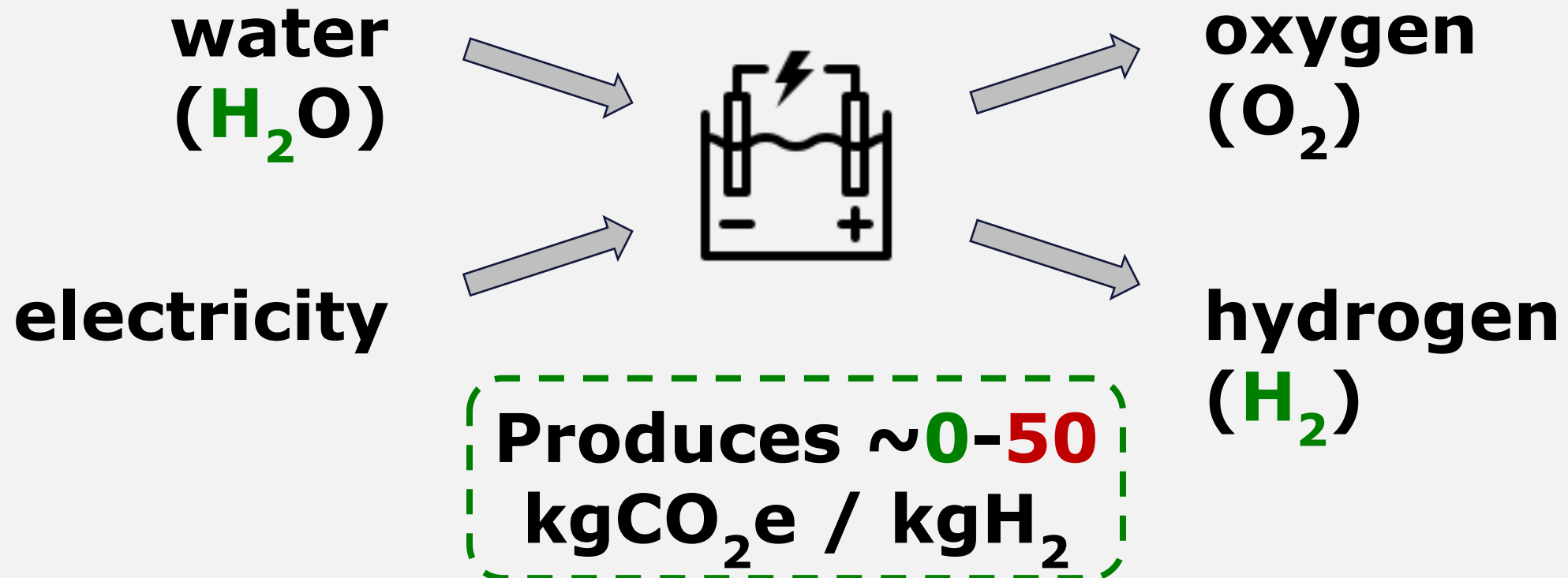
- Hydrogen Basics
- Clean Hydrogen Production Tax Credit (“45V”)
- Loose Guidance
- Stringent Guidance
- Summary



Fossil-Based Hydrogen Production



Electricity-Based Hydrogen Production



Hydrogen Uses

First Wave

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

Second Wave

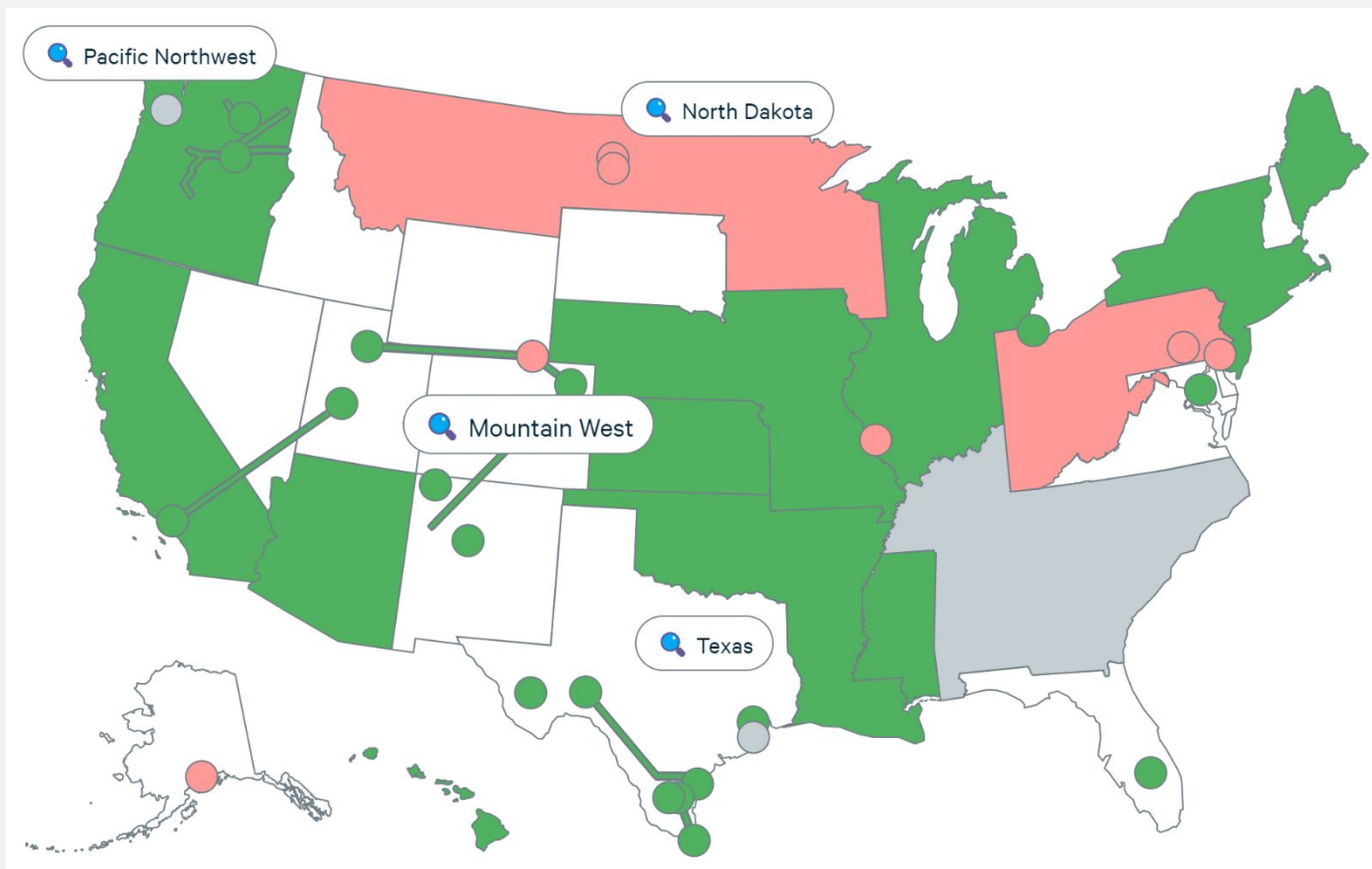
- **Chemicals**
- **Steel**
- **Energy storage**
- **Power gen**
- **Aviation**
- **MDVs**

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)



Renewables is a feedstock

State or Multi-State Hub

Renewables is not a feedstock

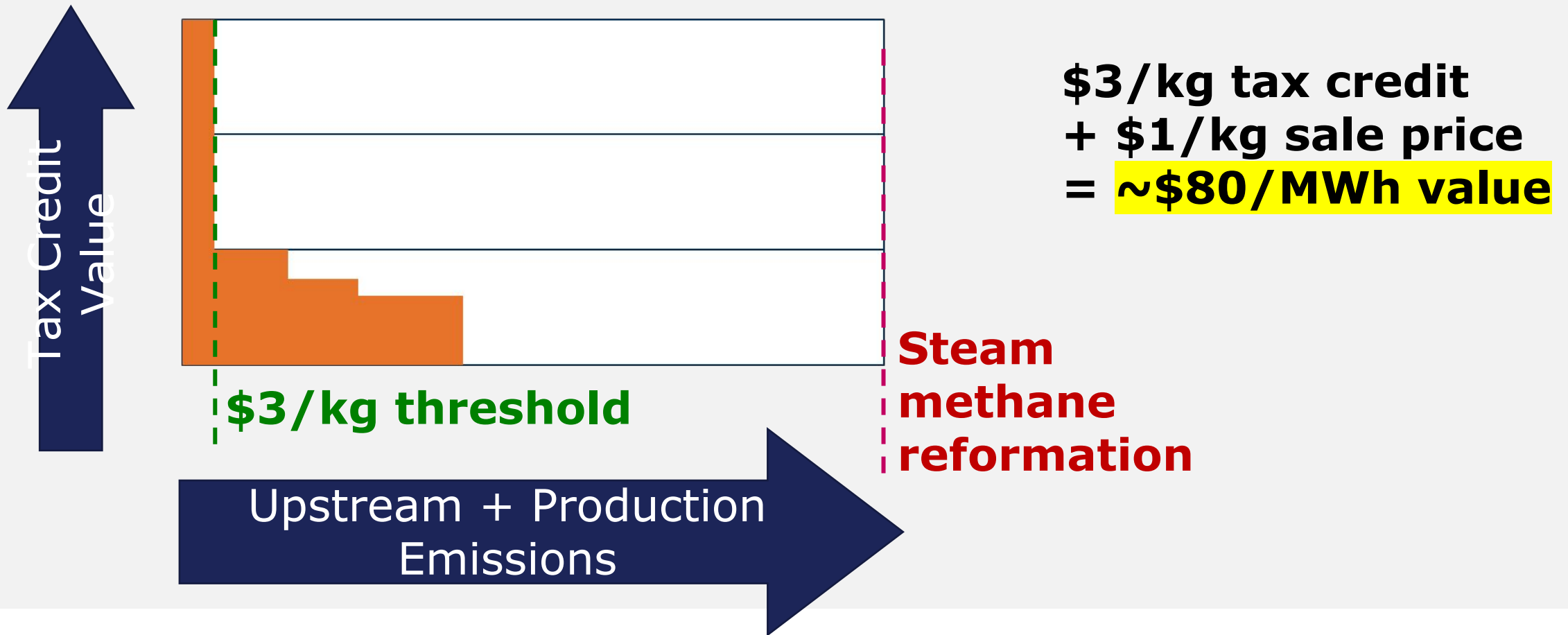
State or Within-State Hub

Renewables feedstock status unknown

Pipeline/Transportation

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

45V Clean H₂ Production Tax Credit (IRA)



Load Growth Implications

2030

10 MMT H₂

500 TWh*

2040

20 MMT H₂

1,000 TWh*

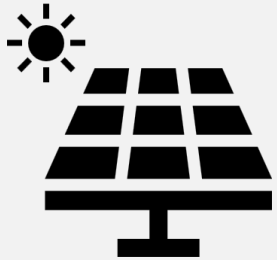
2050

50 MMT H₂

2,500 TWh*

*Assumes H₂ supplied fully by best-in-class electrolyzers (50 kWh/kg)

Pillars for Measuring Electrolyzer GHGs



Additionality – use *new* sources of clean electricity



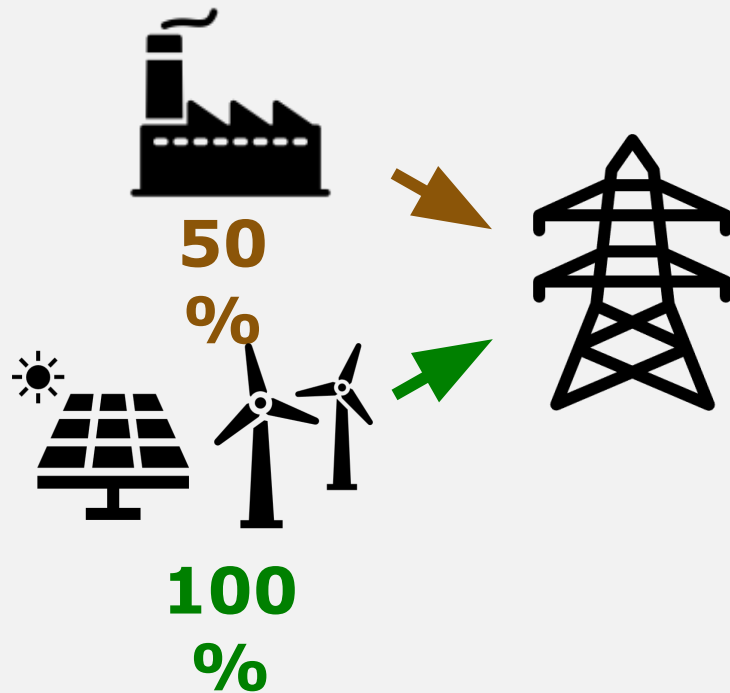
Deliverability – use *local* sources of clean electricity + account for transmission line losses



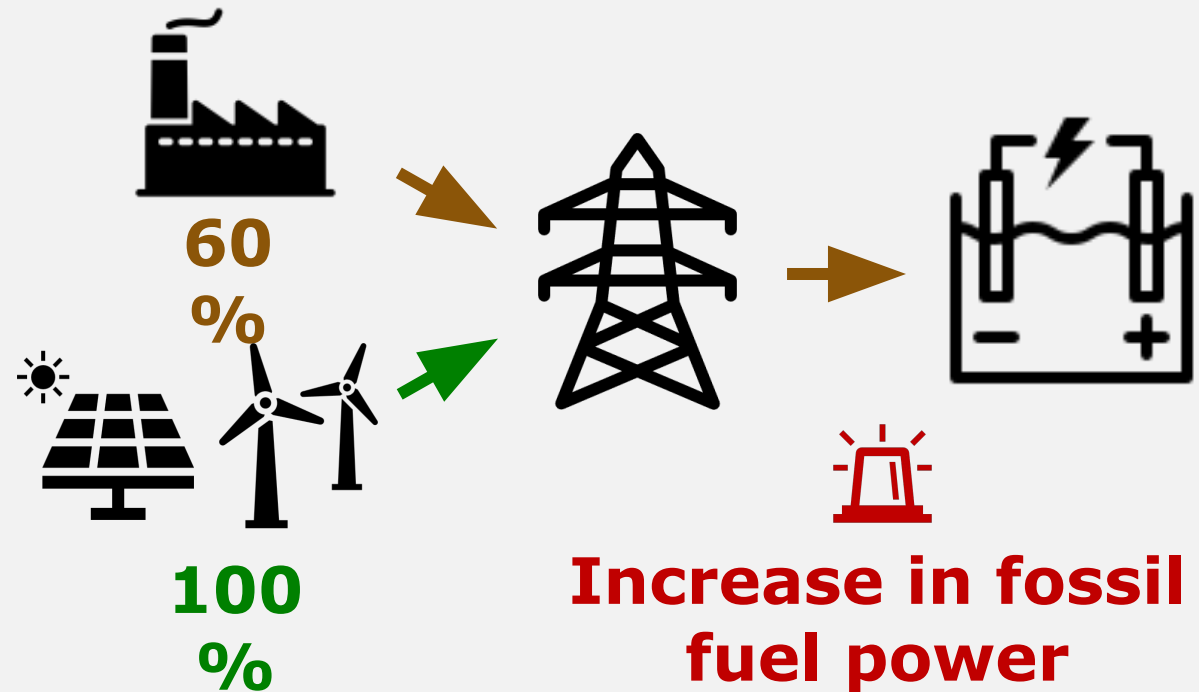
Time-matching – ensure electrolyzer runs at same time of clean electricity generation

Additionality – Overview

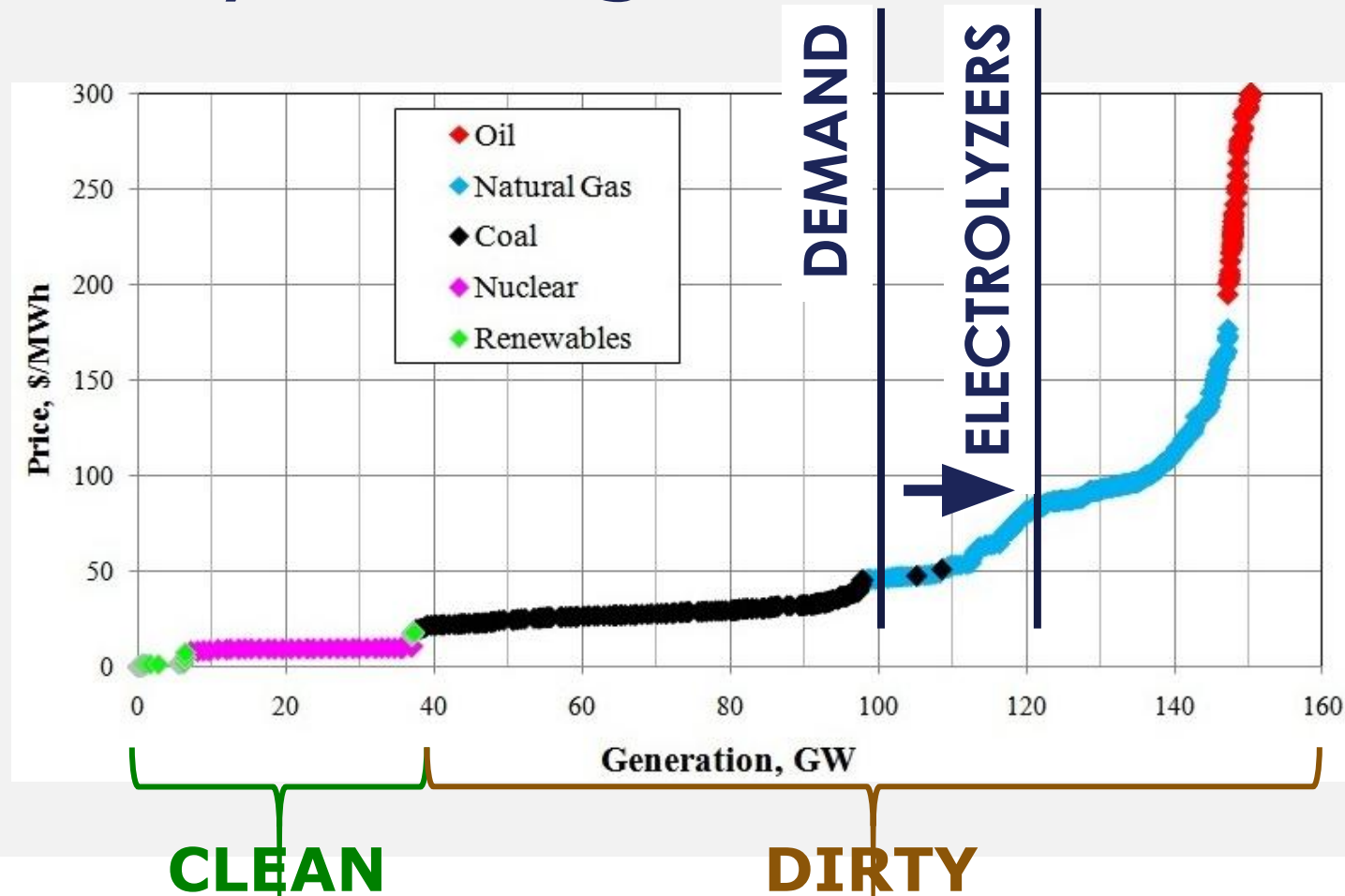
No Electrolyzer



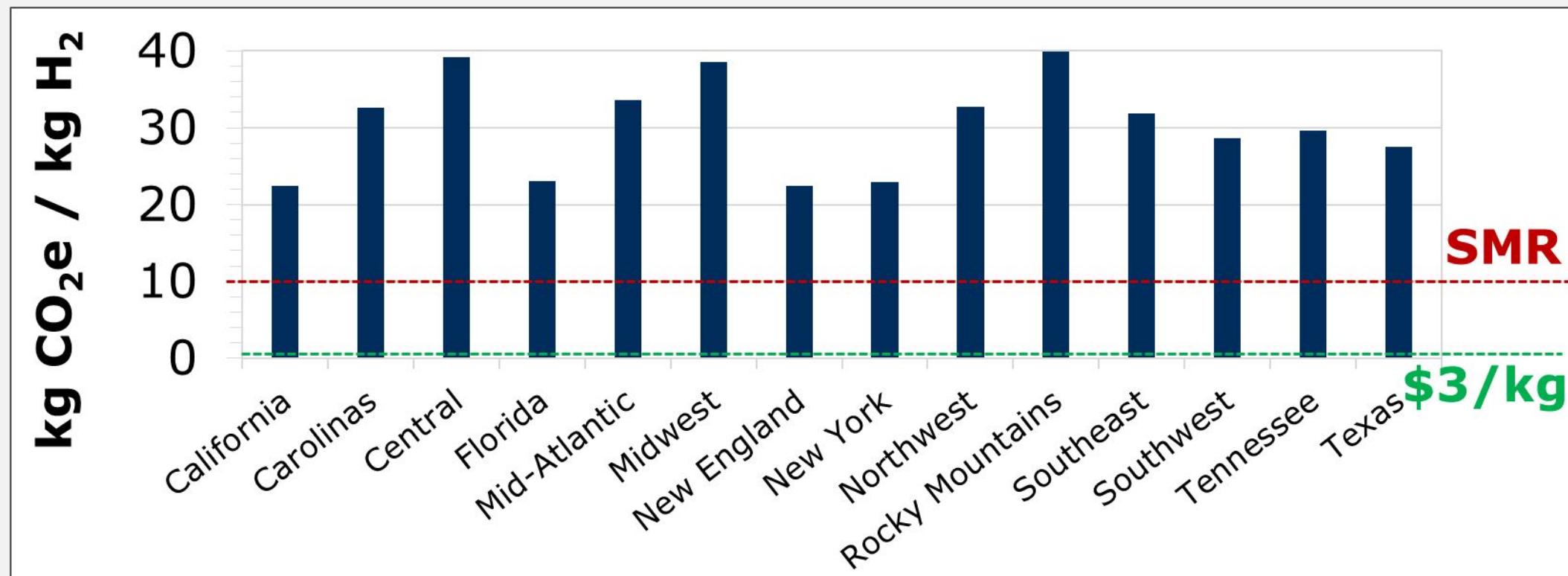
Dirty Electrolysis



Additionality – Marginal Demand

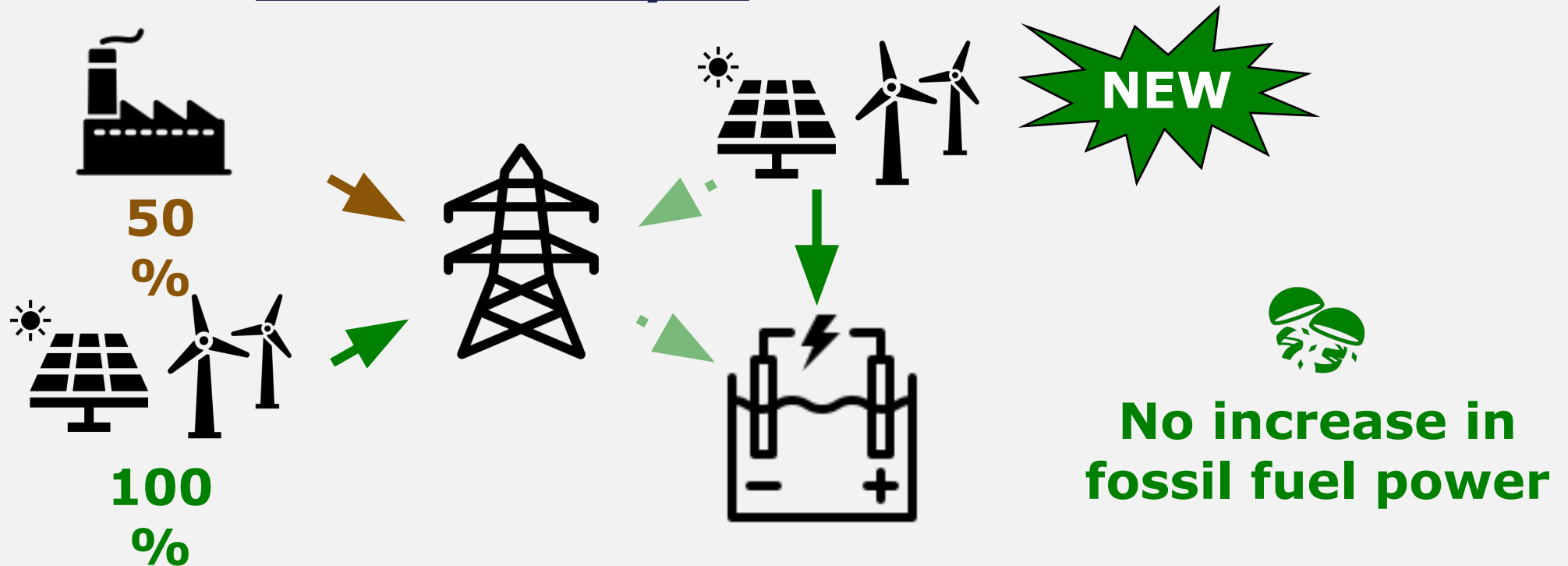


Additionality – Emissions Risk

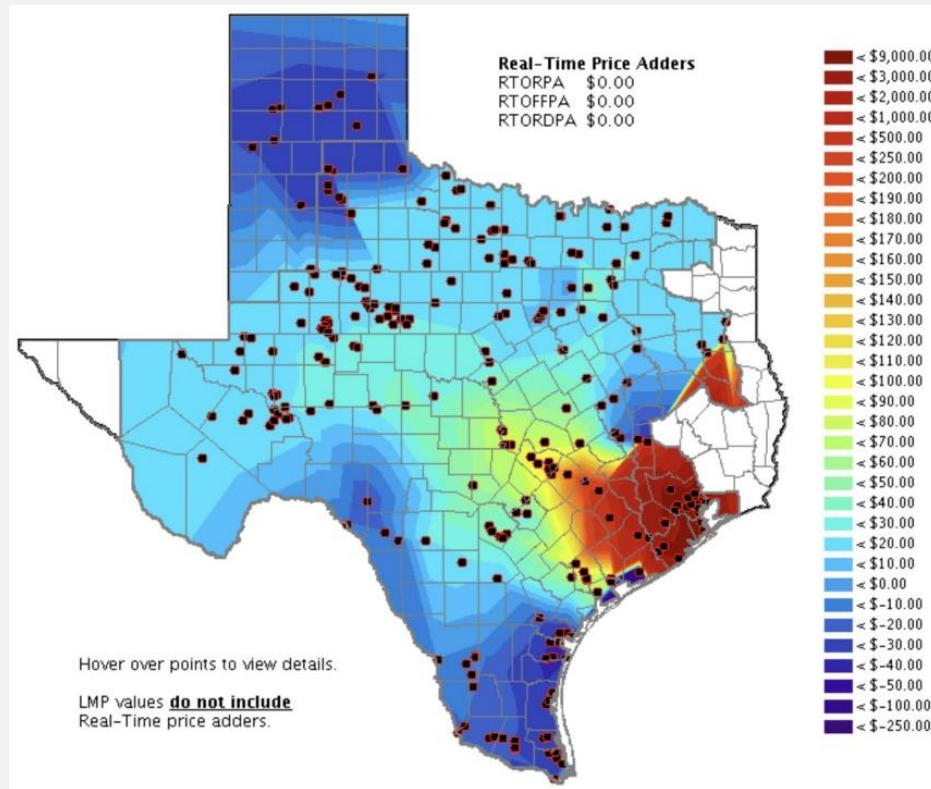


Additionality – Solution

Clean Electrolysis

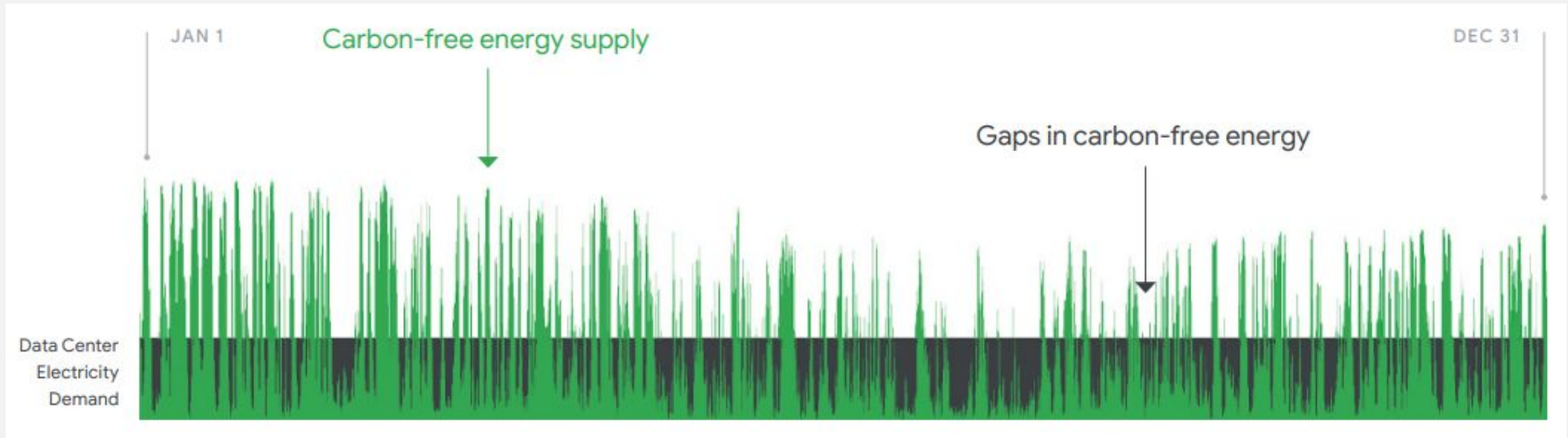


Deliverability



Emissions risk up to
 $\sim 17 \text{ kgCO}_2/\text{kgH}_2$

Hourly Time-Matching

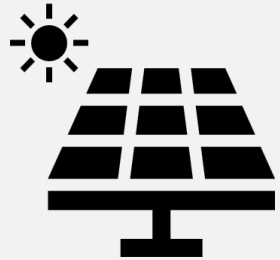


Short-run emissions risk is modest but $>0.45 \text{ kgCO}_2/\text{kgH}_2$

Long-run emissions risk is $>20\text{kgCO}_2/\text{kgH}_2$

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

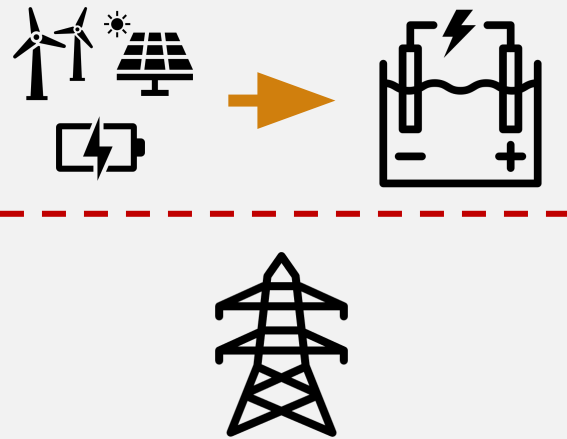
- Signed within 2-3 years of new clean energy coming online
- 10+ years
- Provides evidence that electrolyzer was key to financing

Hourly Clean Energy Credits

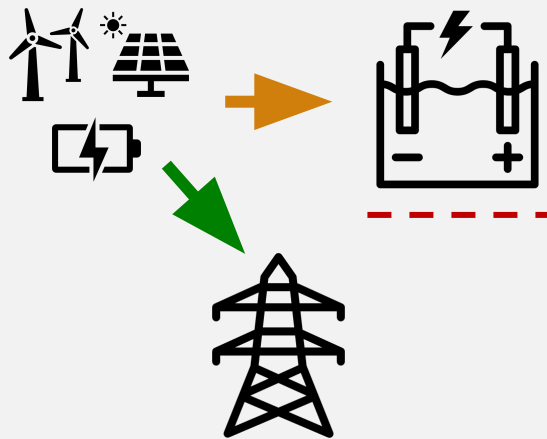
- Contain vintage, location, and time attributes
- Can be ready everywhere by 2026

Types of Project Designs

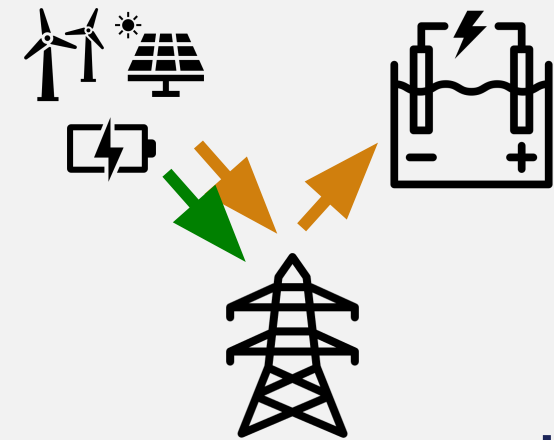
OFF-GRID



EXPORT-ONLY

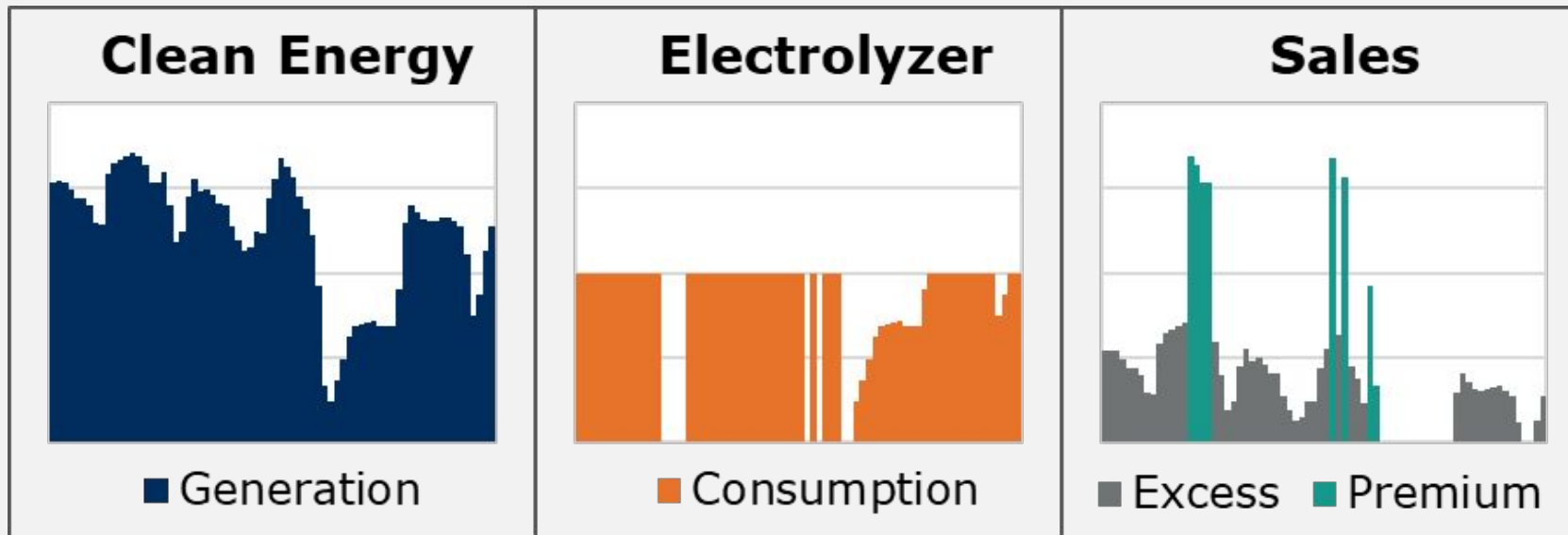


DETACHED

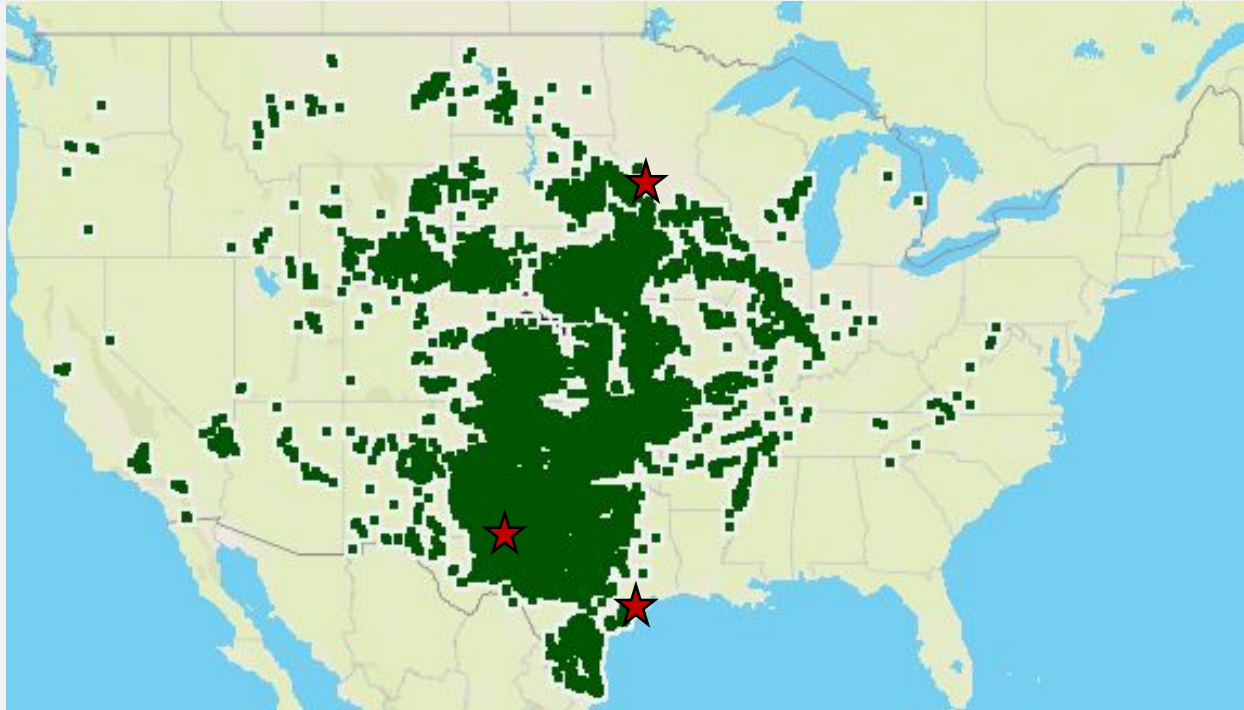


GRID-CONNECTED

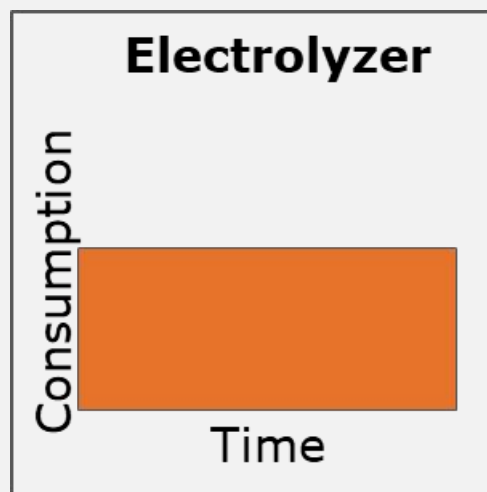
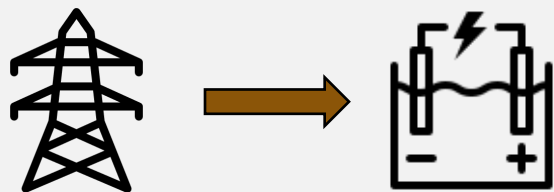
Grid-Connected Project Operations



Export-Only Project Economics (Day 1)

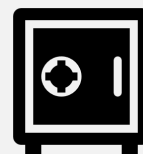


Loose 45V Guidance – Overview



24/7

Run around the clock

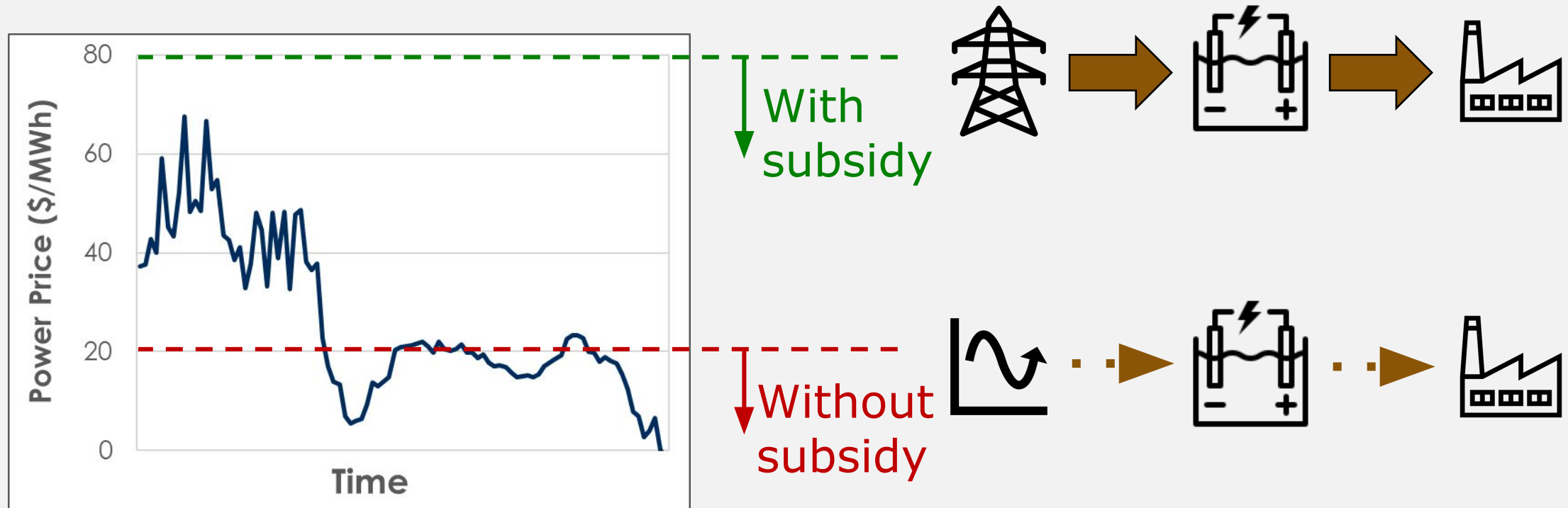


Maximize gov't subsidies



No need for H₂ storage

Loose 45V Guidance – Problem



Loose 45V Guidance – Consequences

Option 1:

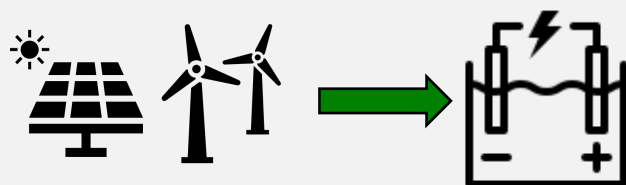
Stranded Assets
Lost Jobs
Derailed Industry



Option 2:

Subsidy Extension
More GHGs
More 24/7 Loads
Delayed Problem

Stringent 45V Guidance – Overview



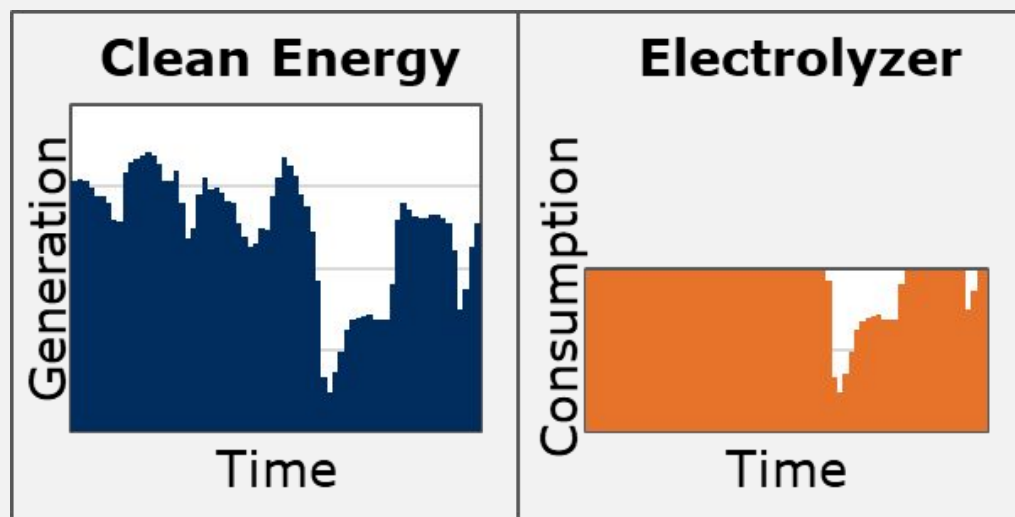
Ramp up and down



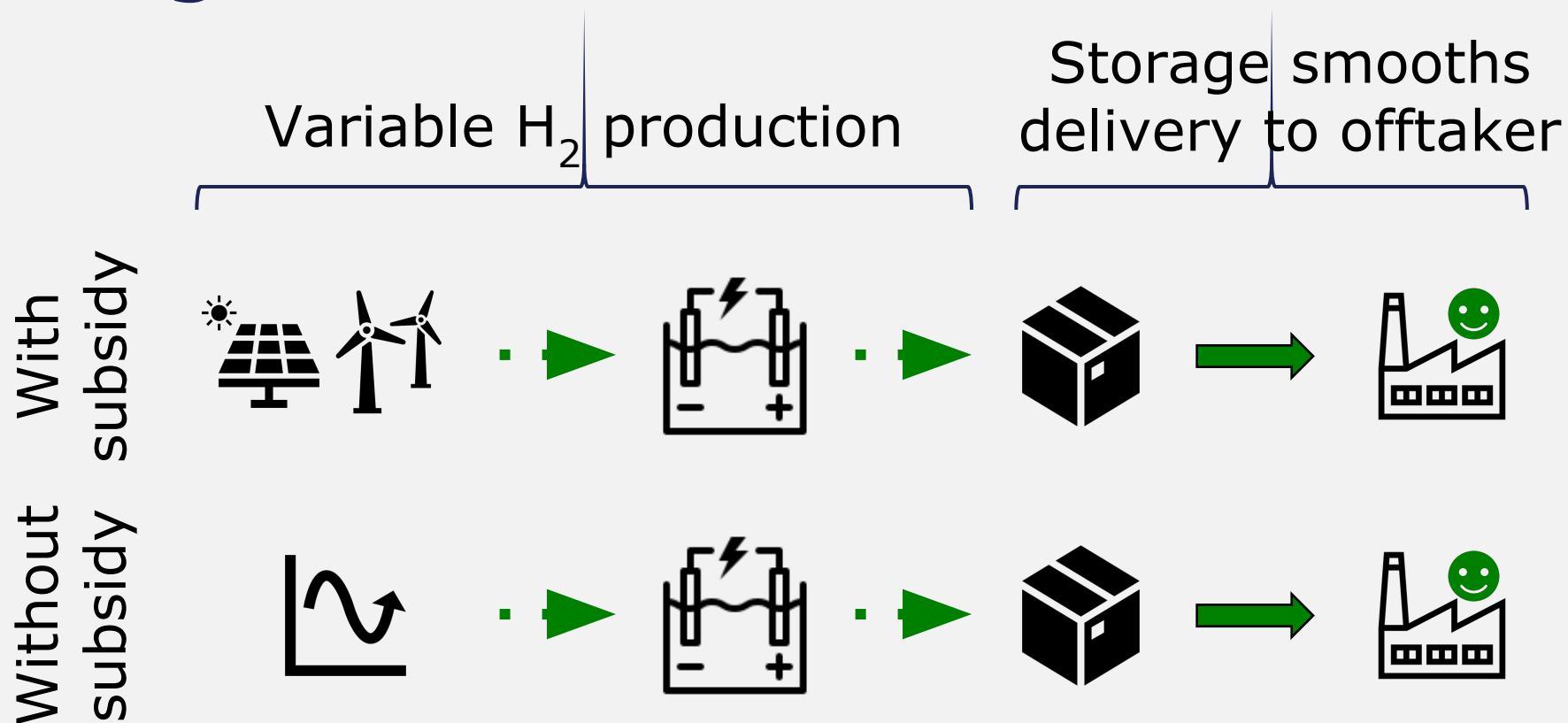
Fewer gov't subsidies



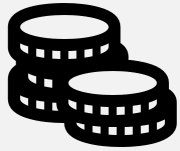
H₂ storage to firm output



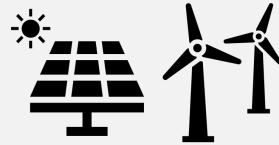
Stringent 45V Guidance – Sustainability



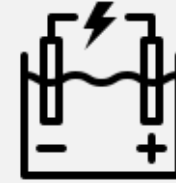
Stringent 45V Guidance – Grid Benefits



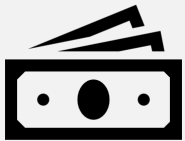
Very low or
negative power
prices



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

Dan Esposito

@danespo14

@EnergyInnovLLC

www.energyinnovation.org

ENERGY
INNOVATION
POLICY & TECHNOLOGY LLC

Read more!
**Google
"Energy
Innovation
45V"**

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

DAN ESPOSITO, ERIC GIMON, AND MIKE O'BOYLE

APRIL 2023¹

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

¹ This research is accessible under the [CC BY](https://creativecommons.org/licenses/by/4.0/) license. Users are free to copy, distribute, transform, and build upon the material as long as they credit Energy Innovation Policy & Technology LLC[®] for the original creation and indicate if changes were made.

ENERGY
INNOVATION
POLICY & TECHNOLOGY LLC[®]

www.energyinnovation.org

98 Battery Street, Suite 202
San Francisco, CA 94111
policy@energyinnovation.org