

Opportunities and Risks of Carbon Markets for Dairies, Digesters & Beyond

Carbon Market Economics and Risks

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Seeing the Forest through the Trees



The Forest: Improving dairy sustainability.



The Trees: The multitude of risks facing dairy farmers to achieve the sustainability goals of the forest.

Risk and opportunity

- Developing regulatory and voluntary carbon markets
- Developing science on quantifying carbon capture, sequestration, etc.
- Risk creates potential for profits or losses
- *Methane capture investment by the dairy farm faces risk in all 5 agricultural risk categories*

5 Risk Categories

1. **Production risk – *Variation in yield***

- Measurement and variance in biogas yield (methane to CO₂e)
- Depends on system AD vs lagoon cover, temperature, electricity vs natural gas
- Engineering design, construction and potential capacity constraints
- Maintenance and management

2. **Market risk – *Variation in input and market prices***

- Regulation created (i.e. LCFS) market and methane capture incentives
- Developing voluntary carbon markets for methane / CO₂e capture
- Electricity and natural gas prices
- Value from RINs and potentially eRINs

3. **Finance risk – variation in cash flow**

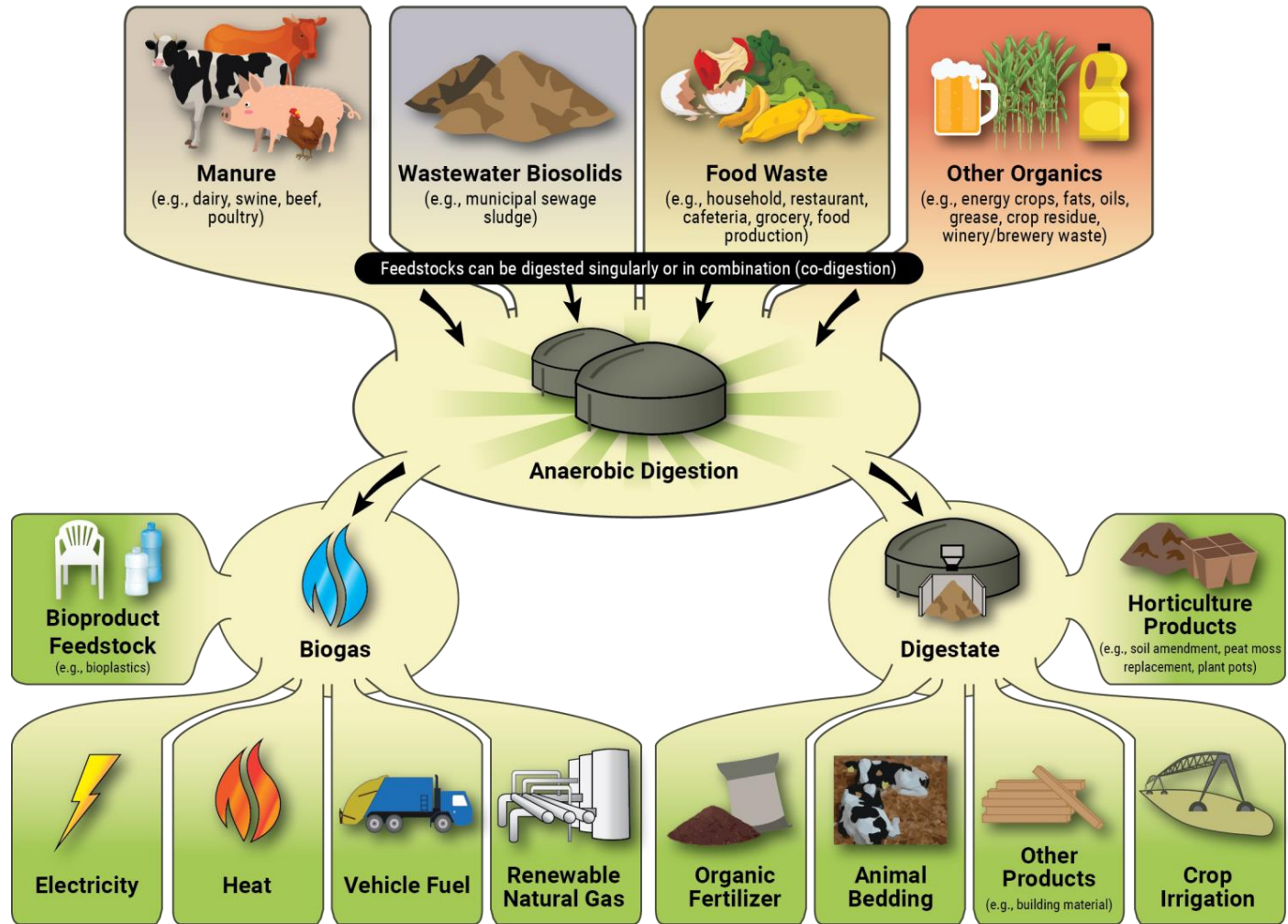
- Long investment recovery period – 15+ years
- Tax incentives – Depreciation; Federal Investment Tax Credits
- Low dairy milk production profitability & ability to cover biogas losses

4. **Legal risk – Legal and regulatory rules**

- Policy permanence – adverse policy initiatives
- Contracts, Nondisclosure clause in contracts, new biogas LLC

5. **Human risk – Business risks from dealing with people and new management challenges**

Anaerobic Digestion Production of Gas and Electricity



Clean Fuel Standard (WA), LCFS (CA) Prices, RINS (Fed RFS), Incentives

<https://www.epa.gov/agstar/how-does-anaerobic-digestion-work>

Renewable Natural Gas (RNG) from Dairy Manure

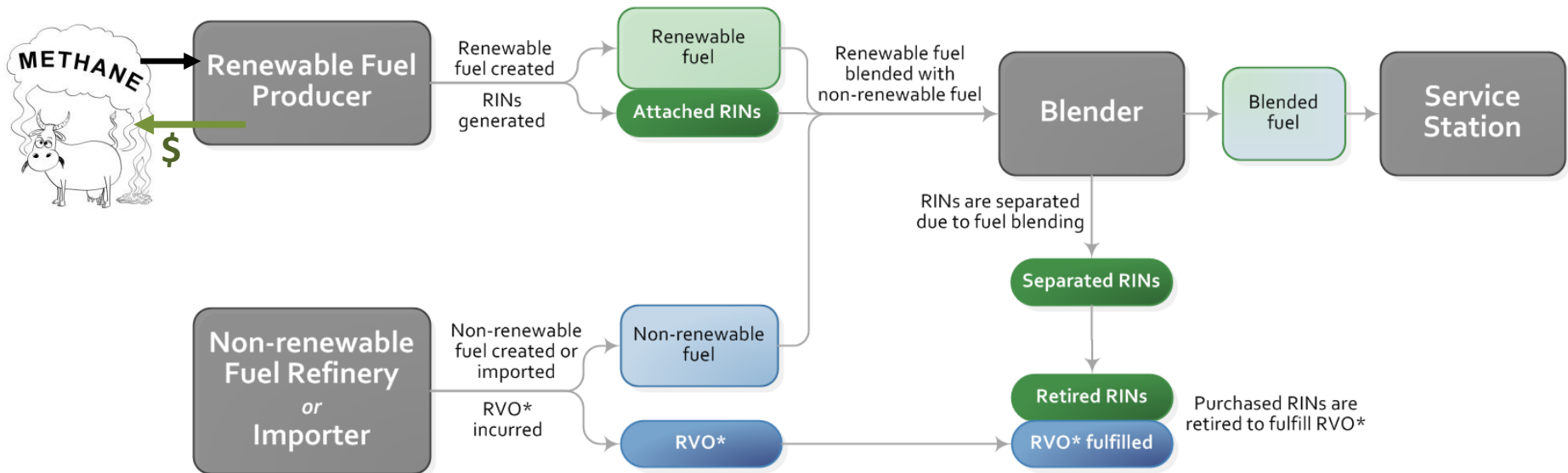
Value of RNG from Dairy manure Anaerobic Digestion

1. Commodity natural gas price
2. Low carbon fuel credits (LCFS in CA, CFS WA)
3. RINS (Renewable Identification Numbers)

“Currency” of the Federal Renewable Fuel Standards (RFS) Program

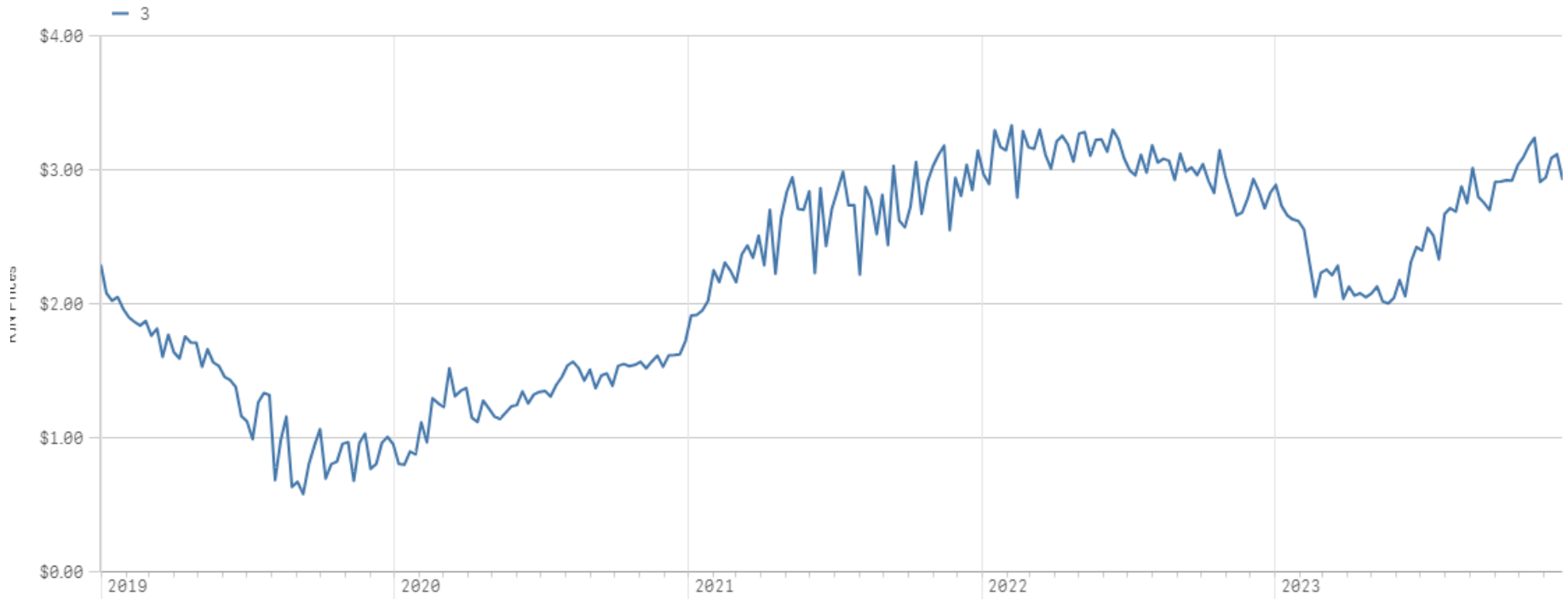
RVO = Renewable Volume Obligation to sell, set by EPA rulemaking

Example lifecycle of a Renewable Identification Number (RIN)



RINs - D3 cellulosic, D5 advanced, D4 biodiesel, D6 corn ethanol

Weekly D3 RIN Prices 2019 through 2023 (\$/RIN)



D3 RINs: “cellulosic” includes landfill biogas and agricultural digesters (**Dairy**)

RIN (Renewable Identification Number) is a **38-character number assigned (“tied”) to each physical gallon of renewable fuel produced or imported.**

<https://www.epa.gov/fuels-registration-reporting-and-compliance-help/rin-trades-and-price-information>

How much “support” will D3 prices has from future RVOs

EPA D3 RIN /RVO Volume Targets (6/21/2023)

	2023	2024	2025
Cellulosic biofuel (D3)	840,000,000	1,090,000,000	1,380,000,000
Percent Change (YoY)		130%	127%

<https://www.epa.gov/renewable-fuel-standard-program/final-renewable-fuels-standards-rule-2023-2024-and-2025>

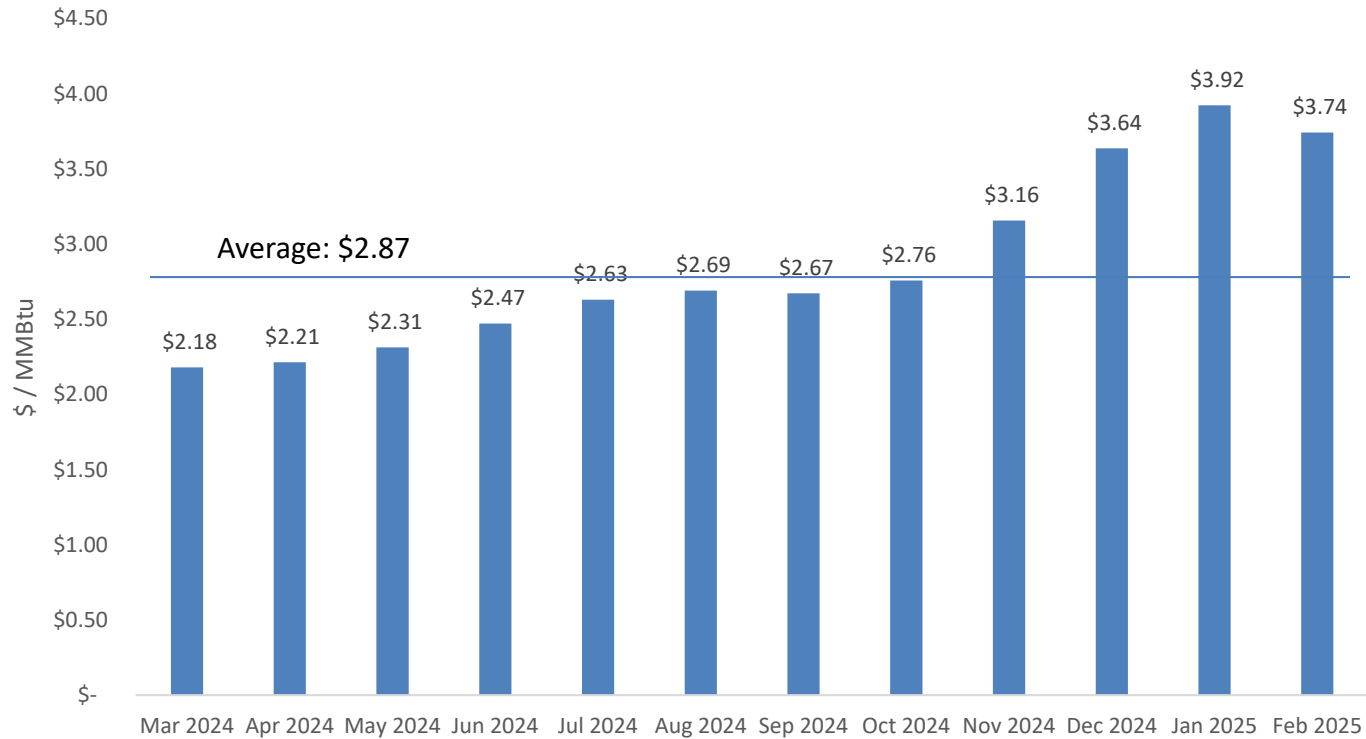
Trend in Natural Gas Prices (2020 to 2024)



<https://tradingeconomics.com/commodity/natural-gas>

CME Natural Gas Futures Outlook

CME Natural Gas Futures Contract Prices (\$ / MMBtu Data collected 1/24/2024)



CA LCFS Price Trend

Weekly Average CA LCFS Price 2019 through Jan 2024
\$/MT



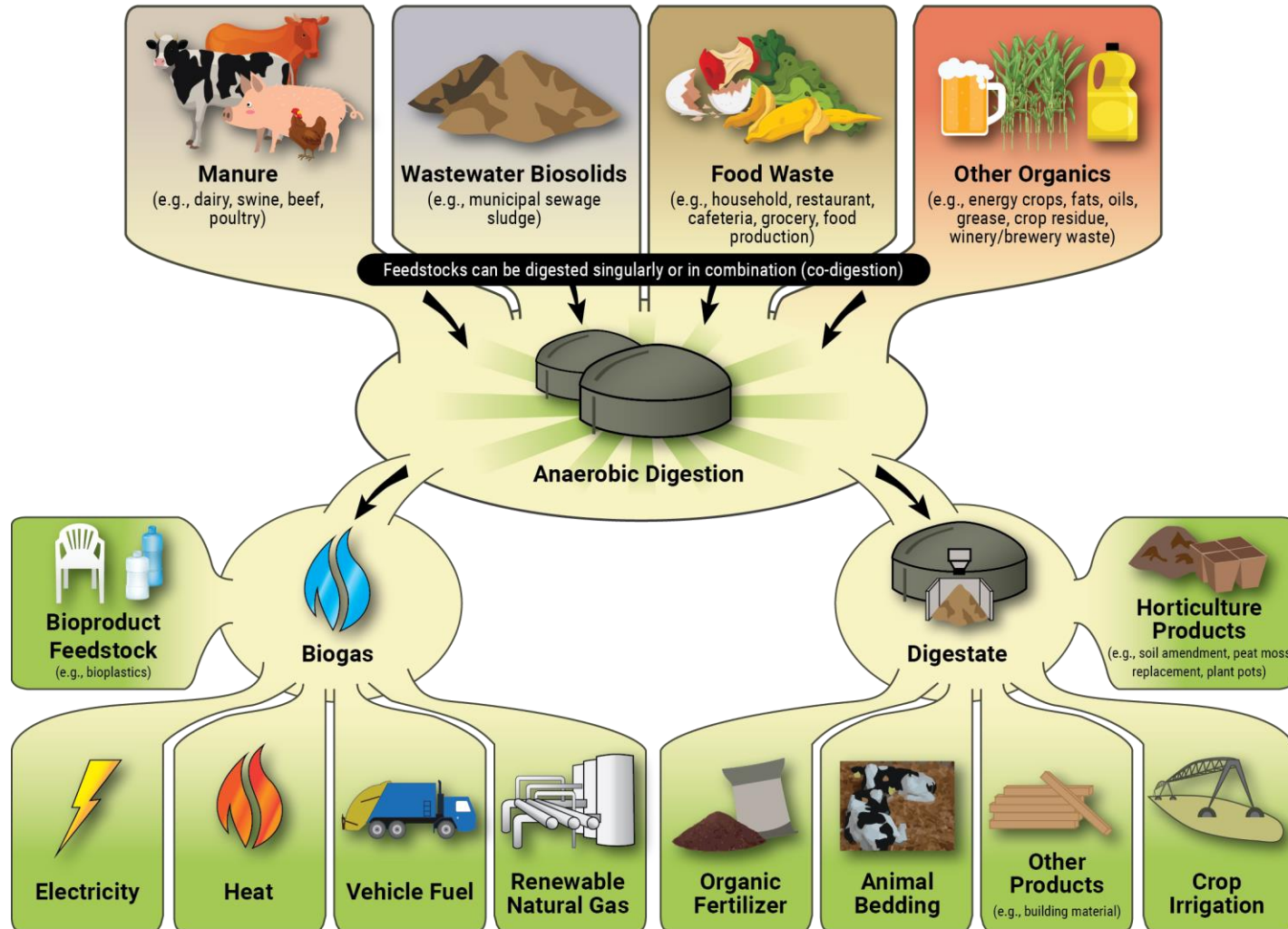
Estimate revenue per cow generated from natural gas

A dairy cow generates about 22.5 MMBTU / Year

			Revenue
Sale of gas	\$2.50 / mm btu	22.5 mm btu	\$ 56.25
D3 RINs	\$3.00 / RIN	254 RINs / cow	\$ 762.00
LCFS	\$68.27 / MT	16.13 / cow	\$ 1,101.20
		Total / cow	\$ 1,919.45
Milk revenue	\$18.5 / cwt milk price	23,000 lbs	\$ 4,255.00

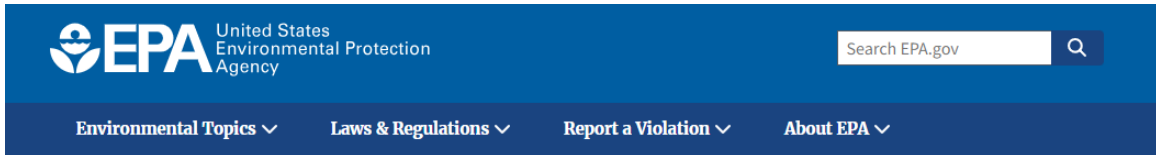
<https://asmith.ucdavis.edu/news/revisiting-value-dairy-cow-manure>

Anaerobic Digestion Production of Gas and Electricity



Profitability of AD generating electricity consideration

eRINs Policy and Outlook



News Releases: [Headquarters](#) | [Air and Radiation \(OAR\)](#)

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EPA Finalizes New Renewable Fuel Standards to Strengthen U.S. Energy Security, Support U.S. Rural Economy, and Expand Production of Low-Carbon Fuels

Final rule sets balanced biofuels growth from 2023 to 2025, reducing reliance on up to 140,000 barrels of foreign oil imports per day

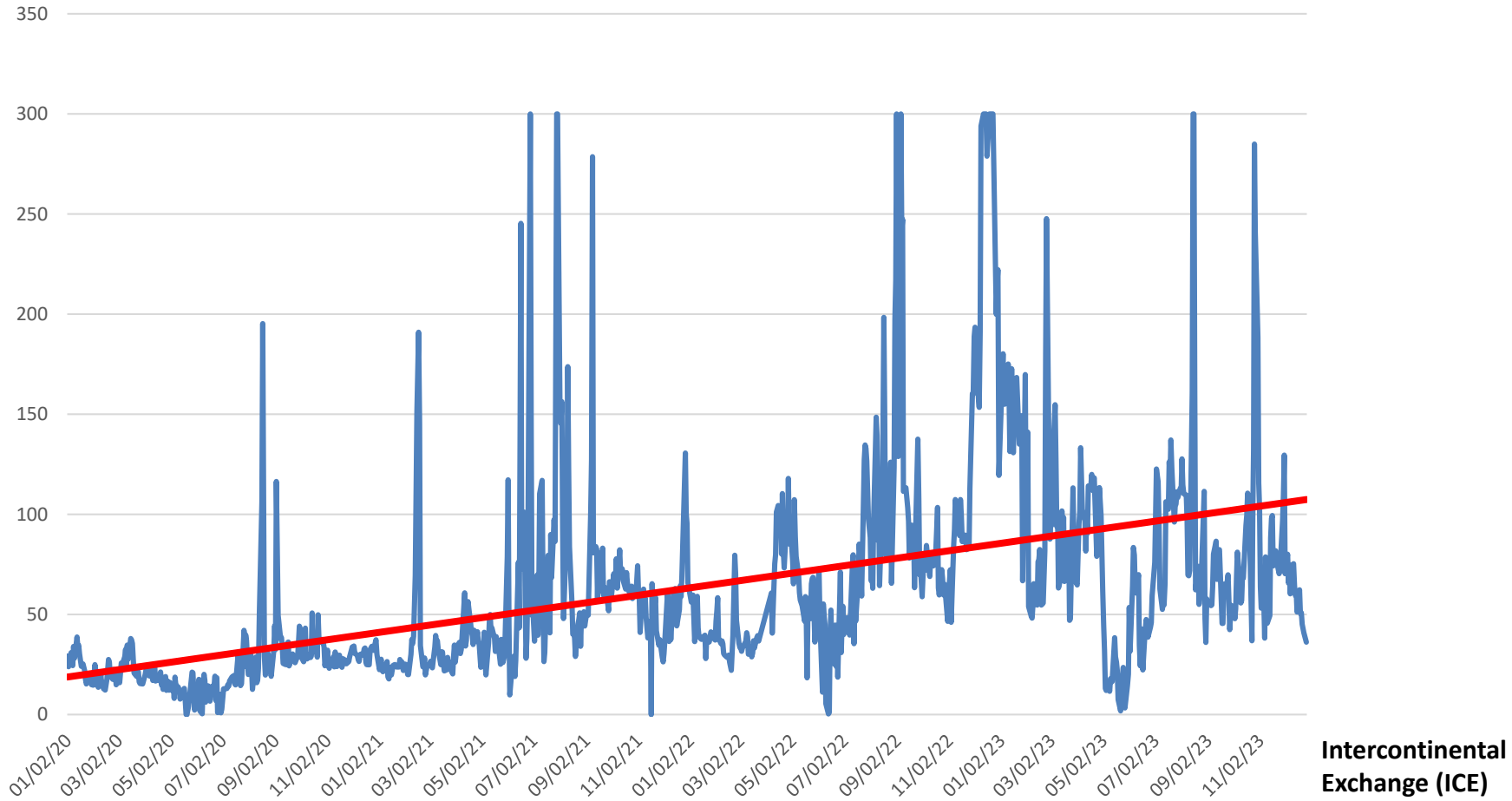
June 21, 2023

EPA continues to assess the comments received on proposed regulations governing the generation of Renewable Identification Numbers (RINs), which are RFS compliance credits, for electricity made from renewable biomass that is used for transportation fuel (eRINs). **The EPA will continue to work on potential paths forward for the eRIN program**, while further reviewing the comments received on the proposal and seeking additional input from stakeholders to inform potential next steps on the eRIN program.

June 21, 2023

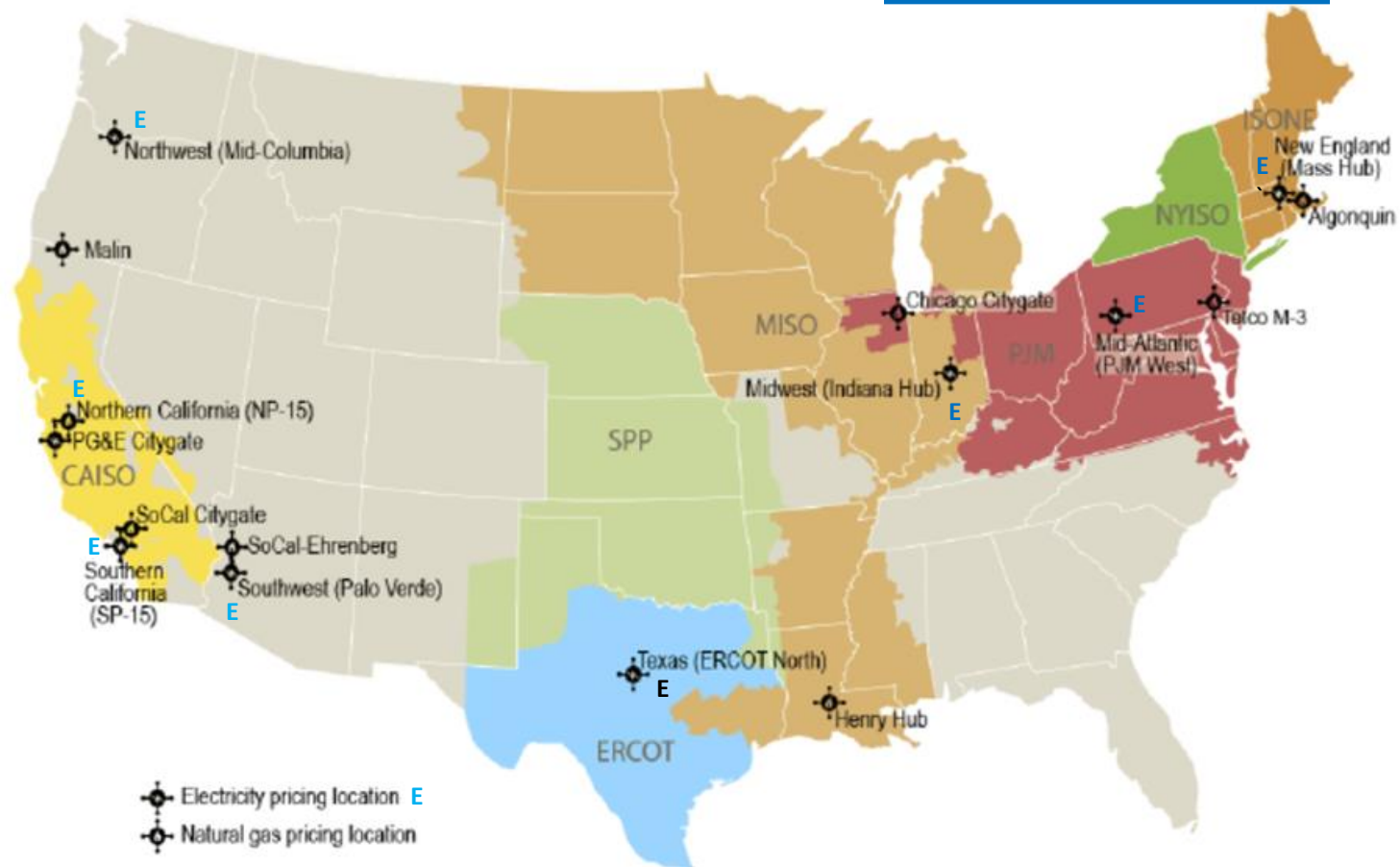
Electrical Wholesale Price Trend

Daily Wholesale Electricity Price Trades at Northwest Mid-Columbia Hub
\$/MWh 2020 through 2023



Electrical Wholesale Price Market Map

Selected price hub locations for wholesale electricity and natural gas reported by Intercontinental Exchange



Note: Colored areas denote Regional Transmission Organizations (RTO)/Independent System Operators (ISO)
Data source: U.S. Energy Information Administration based on Ventyx Energy Velocity Suite



Conclusions - Refocus on the Forest – Dairy Sustainability

- **Commitment to dairy sustainability – Net Zero Initiative**
- Recognize the value trends for capturing methane for
 - Natural gas
 - Electricity
 - Emerging technologies eg. hydrogen capture technology
- Recognize growing importance of carbon credit incentives
 - Programs supporting clean fuel standard
 - Voluntary carbon market
 - Regulated or compliance carbon market
 - <https://carboncredits.com/carbon-prices-today/>
- Low profit potential of Anaerobic Digestion without Incentives
 - Slow growth in dairy anaerobic digestion systems until California air quality regulation and incentive

Discussion and Questions

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