# Great Falls Energy Market Assessment

## Hydrogen and eFuels

October 2024

# About RMI

**RMI is an independent, nonprofit organization of experts accelerating the clean energy transition.** Driven by deep analytics, we aim to transform the energy system to support prosperous and healthy communities for all.

# Meet the RMI Team

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# Agenda

- **Project Overview & Key Takeaways**
- **Hydrogen and eFuels Deep Dive**
  - Current Conditions
  - Opportunities for Improvement
  - Understanding the Costs
  - Solution Pathways
  - Next Steps

# Project Overview & Goals

## WHAT

## Energy Market Assessment

Transmission

Buildings


Hydrogen & eFuels

Industry

## WHO

## RMI, GFDA, + 30 local stakeholders

Government

Innovators

Financial Institutions

Data Analysts

Education & Capacity Building

Local Businesses

## WHY

## Enhance Regional Competitiveness

- To **determine market demand** for increased renewable energy production
- To **understand energy service business needs** including energy efficiency retrofits, wind and solar
- Providing basis for GFDA to **develop a strategy** to implement over the next 3-5 years to attract investment in our trade area.

# Project Key Takeaways

## Competitiveness

The Great Falls trade area, and Montana at large, has historically benefitted from **fossil fuels**. And is **generally underprepared** to capitalize on the transition to clean energy.

The region's existing natural resource and economic assets point towards **wind, eFuels, and green buildings as competitive opportunities** going forward.

## Constraints

Lack of **transmission** and unstable **electricity prices.**

Slow population growth, **limited workforce availability and retention**, and lack of community buy-in.

Minimal access to **cheap, clean power.**

Lack of related existing industries.

## Coordination

**Transmission:** Increased capacity will lead to economic development opportunities.

**Hydrogen & eFuels:** Great Falls already has a foothold in the SAF market; it's time to build out the local supply chain.

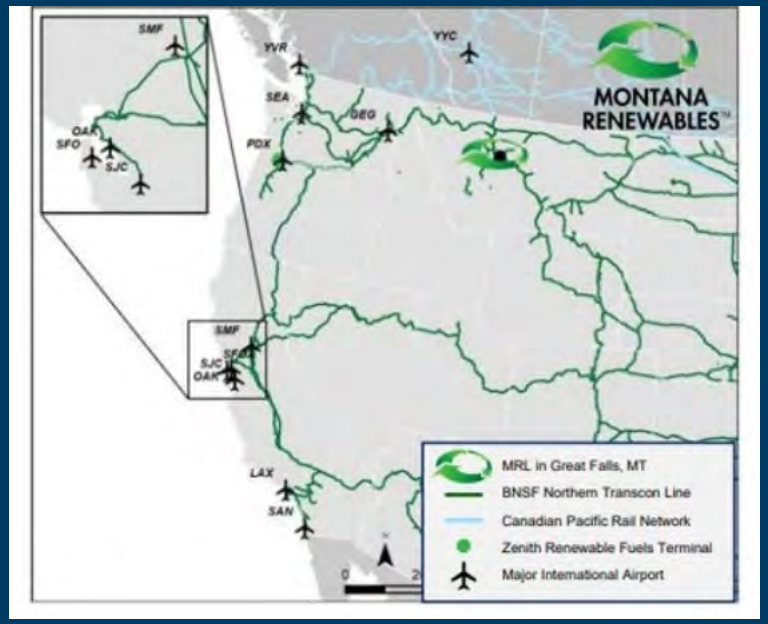
**Buildings:** Need to connect homeowners and developers to federal funding and close information gaps and capacity constraints.

# Hydrogen and eFuels Overview

# Industry stakeholders have high ambitions for Montana's resources

"North America's largest SAF producer by next year [2024]" – Montana Renewables

Montana Renewables Begins Sustainable Aviation Fuel Deliveries to Shell **PR Newswire**




**SUSTAINABLE OILS**

The World's Leading Camelina Seed Company for Renewable Diesel Production

**Sustainable Oils Opens North American Headquarters in Great Falls, MT**

## MT part of $1 billion hydrogen hub

The Pacific Northwest hub plans to produce hydrogen solely via renewable-powered electrolysis, playing a "key role" in lowering the cost of electrolyzers, the DOE said in an October statement. The agency has committed up to $1 billion to the project located in Washington, Oregon and Montana. **S&P Global**

# Investment should continue in the biofuels and eFuels sector.

**“There is potential to develop more renewable products, like the naphtha component, which could be used for hydrogen or cogeneration.”**

- Biofuels Businessperson

**“Access to natural gas is a limitation to further biofuel development…It will take time to source more gas for hydrogen projects."**

- Utility Representative

**“Crushing camelina locally would be great. Transportation is very expensive.”**

– Local Biofuels Consultant

# Great Falls has the experience and resources But infrastructure gaps could stunt potential

## OPPORTUNITIES

- **Hydrogen and other alternative fuels have the attention of investors**
- **Great Falls has access to resources for expanding eFuel production**
- **Low-cost renewable energy potential**
- **Jobs & economic development**
- **Local supply chains support value-added products, like biofuels**

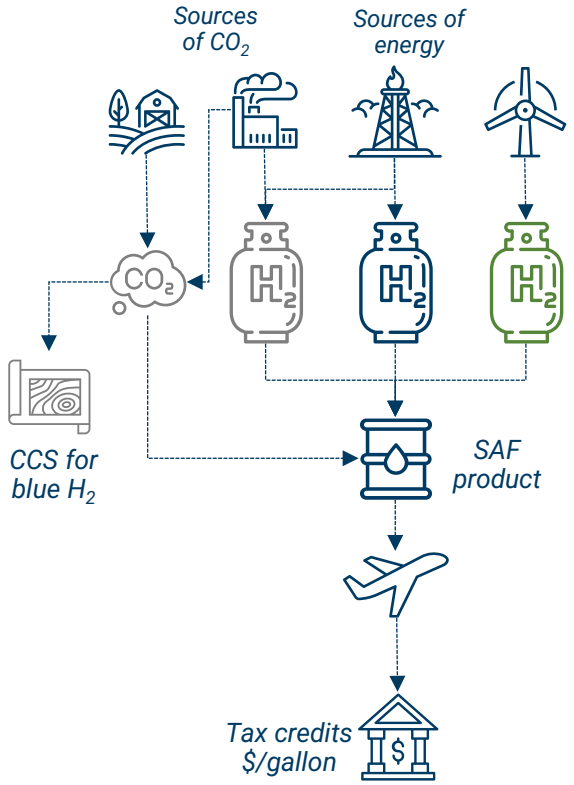
## CHALLENGES

- **Developing new renewable energy capacity with transmission to refinery sites**
  - Permitting bottlenecks
  - Keeping electricity prices low
- **Canadian natural gas is leaky; fuels refined from it are not as competitive**
  - Higher GHG emissions profile
  - Renewable natural gas has not been explored
- **$CO_2$ infrastructure is concentrated in eastern Montana**

# New fuel pathways have unique requirements

## SAF needs low-carbon hydrogen and other feedstocks that Montana can facilitate

- The US has its focus on specific eFuels:
  - *Sustainable Aviation Fuels (SAF)*
  - *Hydrogen*
- **Hydrogen is needed to make SAF**, especially power-to-liquid (PtL) fuels
- **Power-to-liquid fuels combine CO2, hydrogen, and electricity to produce hydrocarbons** nearly identical to diesel and jet-fuel, but without including any fossil fuels. These fuels, often known as Renewable Diesel and SAF, are blended with fossil fuels and used directly in existing engines. Commercial aircraft can include up to 50% of SAF in its fuel.
- **Bio-based SAF (HEFA)** is produced by combining hydrogen with a biofeedstock like soybean oil or camelina oil, as is the case with Montana Renewables.

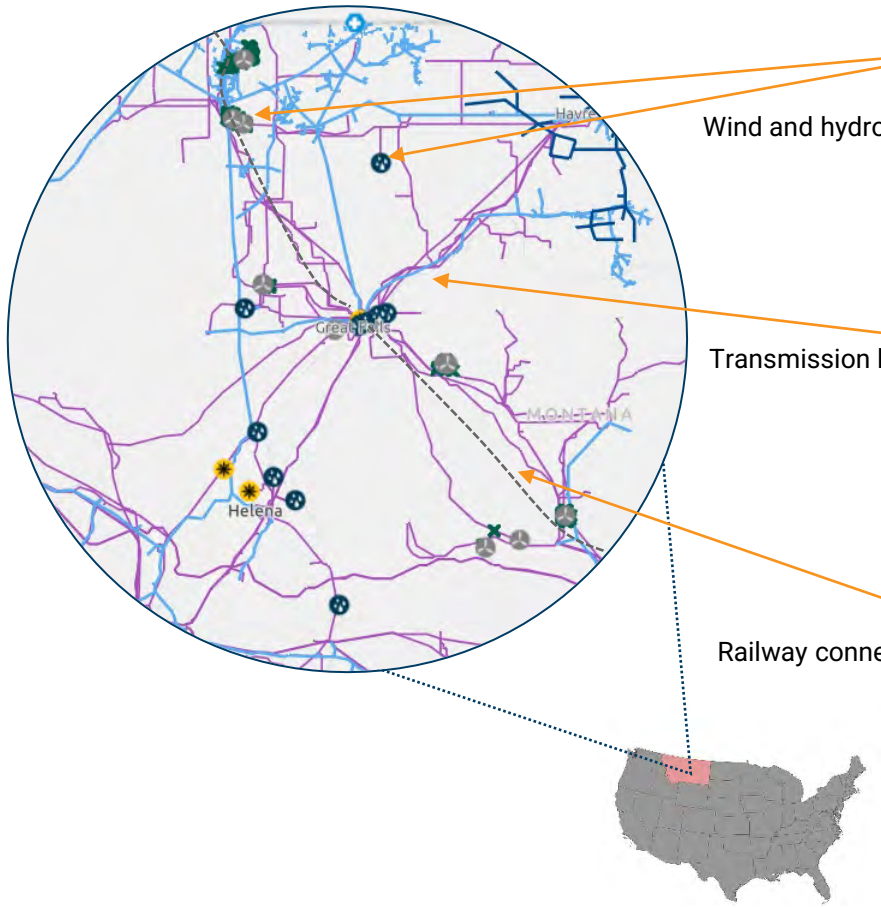


# Refining and electricity are ready to scale

## Great Falls has the potential to host an advanced fuels economy

**Renewable fuels like hydrogen and sustainable aviation fuel (SAF)** will require large amounts of renewable energy. Low-cost wind and solar development around Montana could support a competitive new hub for advanced fuels. Incentives for the consumption of low-carbon hydrogen and SAF in other states, such as California or Washington, supports production costs regardless of region. Local enterprise can capitalize on the incentive boom.

RMI has interviewed stakeholders in the region to identify areas of opportunity and possible barriers to advanced fuel development in Great Falls.




**Low-carbon Energy**
Abundant wind and hydropower are already in place by experienced energy developers.

**Infrastructure Primed**
Current electricity and natural gas transmission can guide the deployment of new energy resources.

**BNSF Railway System**
Bio-based fuel producers are seeking local camelina, beef tallow, and other feedstocks grown in Montana. BNSF can get it there inexpensively by rail.

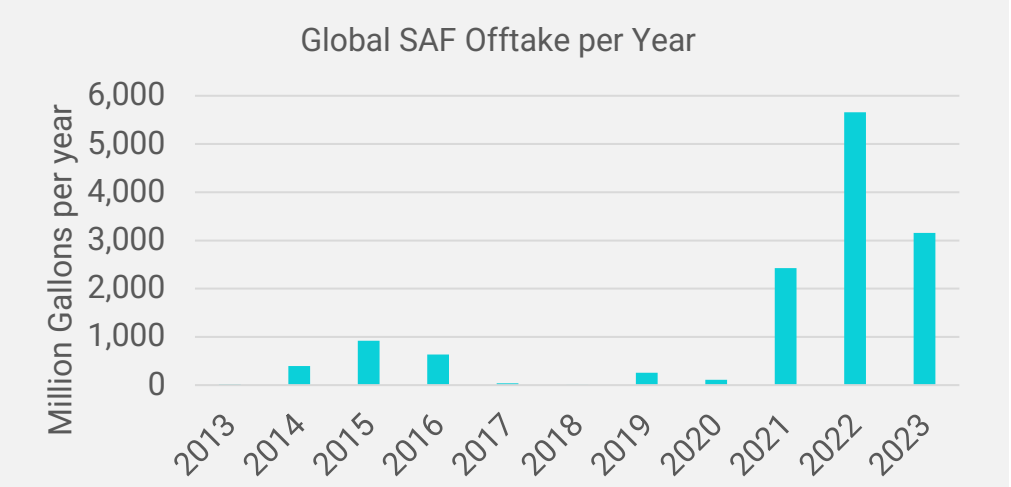


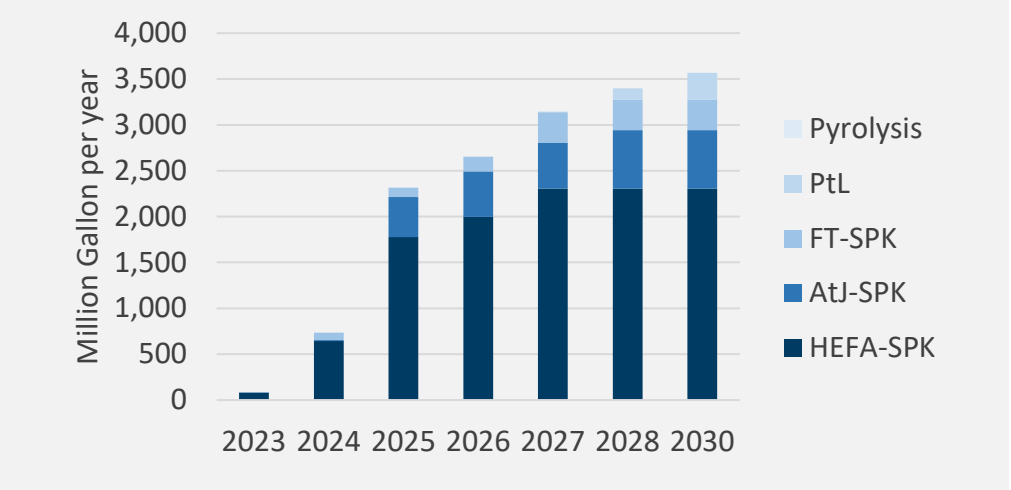
EIA. 2024. Energy Resources Atas. https://atlas.eia.gov/apps/all-energy-infrastructure-and-resources/explore

# New fuel pathways have unique requirements

## SAF needs low-carbon hydrogen and other feedstocks that Montana can facilitate

- **The United States seeks to become a leader of sustainable aviation fuels and low-carbon hydrogen, but currently** falling short of the SAF Grand Challenge goal of 3 billion gallons annually by 2030.
- There is **strong demand for SAF offtake** agreements from airlines and corporates.
- SAFs can be broken down into two categories: **biofuels and eFuels**.
  - Hydroprocessed esters and fatty acids (**HEFA biofuel**) SAF prices range between $6-8/gallon depending on the carbon intensity profile (less carbon = more tax incentives).
  - Fuels developed with electricity and carbon as a feedstock (**eFuels**), which require large amounts of hydrogen.
- The *Hydrogen Shot* goal from the DoE aims to decrease the cost of clean of hydrogen to $1/kg by 2030 – the cheapest low-carbon hydrogen available today is around $2.50/kg after including tax incentives.

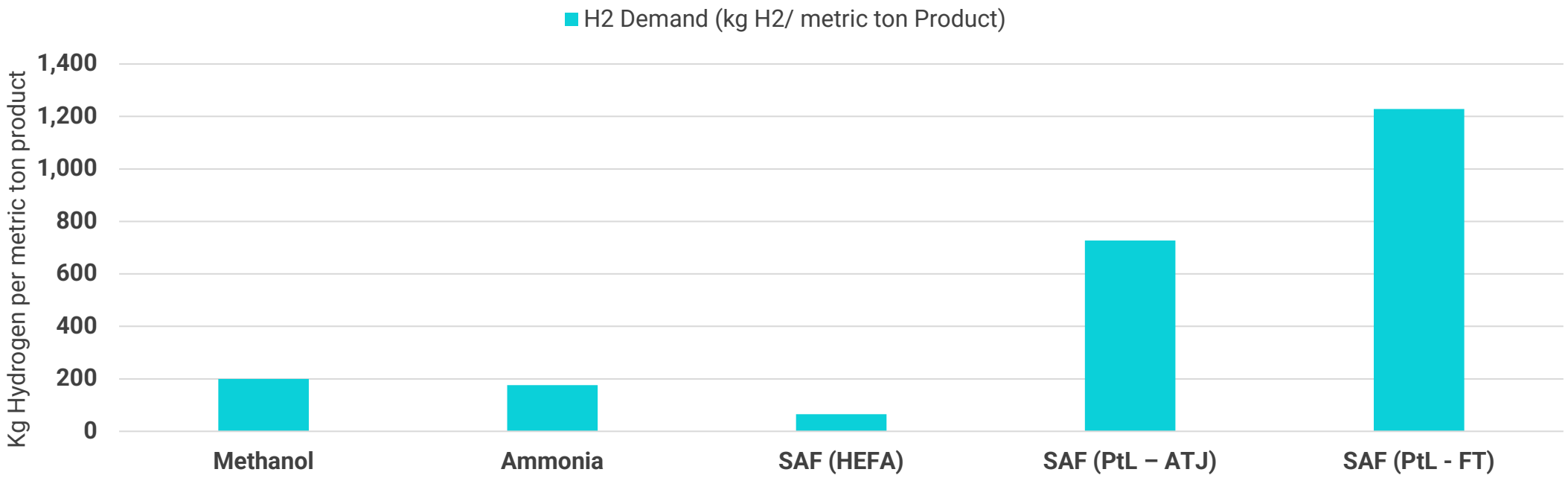



Sourced from: RMI analysis of Argus American Biofuels (2023) and BloombergNEF (2022) data on planned and announced SAF capacity to 2030

# The volume of hydrogen required is based on technology

## eFuels require much larger volumes of hydrogen and therefore more sensitive to prices



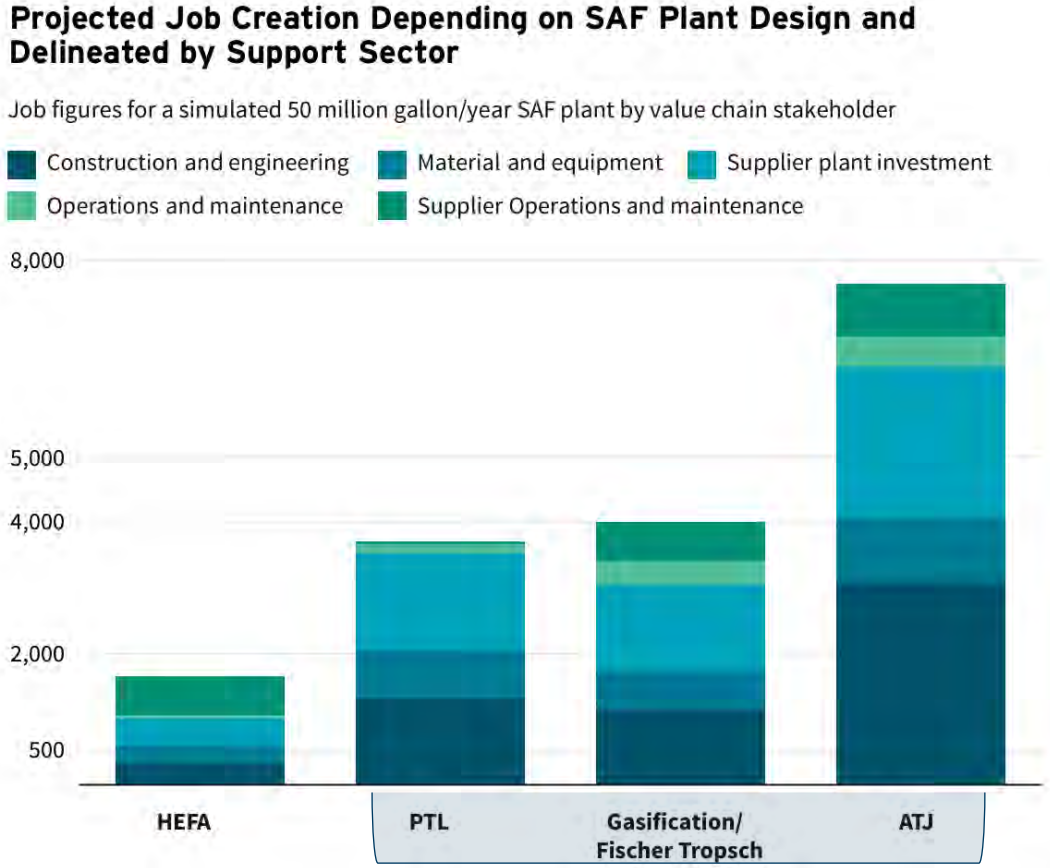

**Major chemical commodities** can also be produced with low-carbon hydrogen

**HEFA SAF requires the least hydrogen** due to the presence of hydrogen in the waste fats, oils and greases used as feedstock.

**Significant quantities of hydrogen** are required for eFuels ATJ (alcohol-to-jet) and FT (Fischer-Tropsch)

# Job creation from hydrogen and efuel

## Power-to-liquid SAF requires a more complex supply chain and workforce



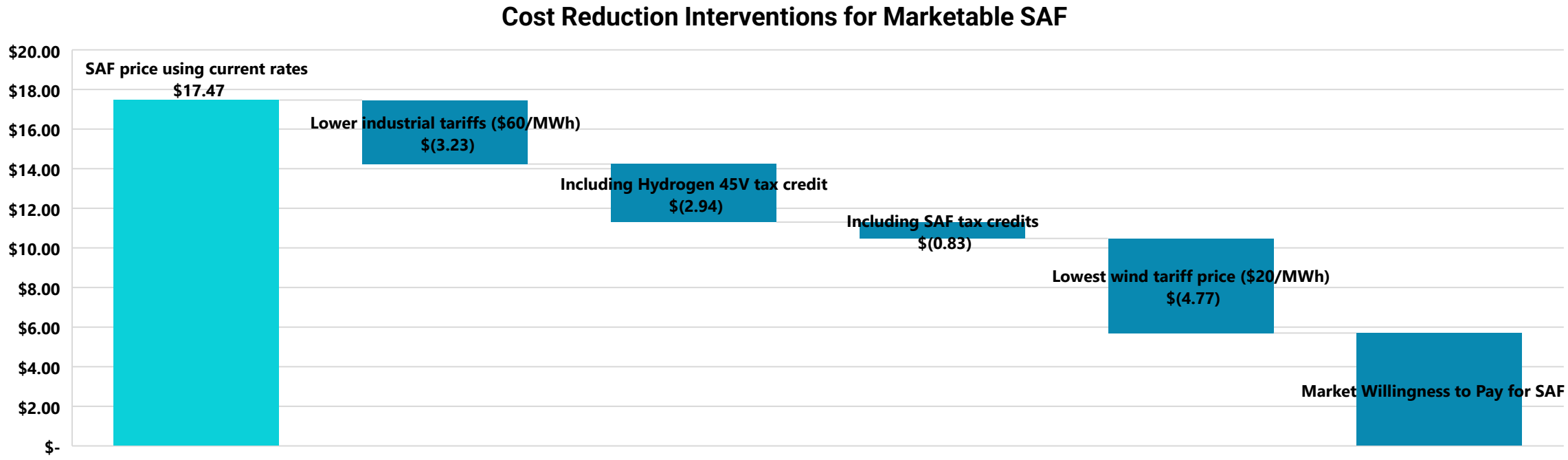

All three are considered power-to-liquid pathways

- The graph visualizes the number of jobs created by each type of SAF refinery with a similar size to Montana Renewables (prior to their expansion).
- The dynamic between hydrogen and SAF creates **multiple levels of jobs in the region**. Beyond upfront construction, suppliers of equipment are needed for hydrogen and eFuels – bringing investments and continuous manufacturing and maintenance.
- Montana Renewables currently employs 300 fulltime workers with an average salary of $140,000. Before expansion, the site still supported hundreds of jobs.
- A PtL refinery of similar scope **can support 2-4x the jobs** of a HEFA refinery.

RMI Graphic. Source: Rhodium Group analysis

# Montana has options to tap into for eFuel deployment

## Various resources within the state can support a foundational eFuels landscape




Malmstrom Airforce Base purchases electricity for $105/MWh

A lowered electricity tariff; $105 → $60/MWh

Adding the hydrogen production credit (45V), and SAF credits 40B, 45Z, CA-LCFS

Using lowest wind energy tariffs offered;
$60 → $20/MWh

Final market willingness-to-pay for SAF; $5.70/gal



DOE. 2024. Land-Based Wind Market Report.
EPA FLIGHT Database. 2024

# Great Falls Potential Electricity Prices

## Simulated Hydrogen and SAF prices are banking on low-cost renewable electricity

| Electricity Scenario | Price of Renewable Electricity ($/MWh) | Price of Hydrogen Production ($/kg) - subsidized | Price of PtL SAF – unsubsidized ($/gallon) | Price of PtL SAF – subsidized ($/gallon) |
|---|---|---|---|---|
| Simulated to meet market WTP | 20 | 0.70 | 6.53 | 5.70 |
| RMI partnered hydrogen developer | 60 | 3.09 | 11.96 | 11.14 |
| Malmstrom Airforce Base (Industrial rates)[1] | 105 | 5.51 | 17.47 | 16.64 |



[1]https://findenergy.com/mt/cascade-county-electricity/

# Montana has options to tap into for eFuel deployment

## Various resources within the state can support a foundational eFuels landscape

### Tapping into local sources of $CO_2$ expands the options for hydrogen and eFuels.

- Hydrogen can utilize $CO_2$ pipelines, like the Denbury Carbon Pipeline, to sequester $CO_2$ into Eastern Montana's sequestration wells, creating a valuable blue hydrogen.
- SAF and renewable diesel are produced with hydrogen and $CO_2$ from industry or waste.
- Landfills and other facilities with biomass have large volumes of biomethane, or renewable natural gas. It can be injected into existing gas lines and purchased on a crediting basis.

### Montana Sources of $CO_2$ for eFuel production




EPA FLIGHT Database. 2024

# Stakeholders are now vertically investing

## Various resources within the state can support a foundational eFuels landscape

- The company *Sustainable Oils* is working to expand camelina growth in Montana's agriculture, which has been a leader in camelina production.
- Its parent company has already purchased a California refinery to produce 220 million gallons per year of renewable diesel – contracted by ExxonMobil. The refinery relies on soybean oil but is planning to switch to camelina once volumes are on the market.
- Sustainable Oils has worked with farmer holdings of 15,000 – 45,000 acres of camelina. For perspective, Montana Renewables would need up to 1.4 million acres to fully convert from soybean to camelina.

| | |
|---|---|
| Sustainable Oils | **Local**<br>• Agricultural aggregators<br>• Growers |
| MONTANA SPECIALTY MILLS<br>BIG SKY QUALITY INGREDIENTS | **Local**<br>• Oilseed crushers<br>• Bio oil aggregators |
| ExxonMobil Denbury | **Interstate**<br>• Bio oil offtakers<br>• Refiners (SAF/RD) |



EPA FLIGHT Database. 2024

# Three fuels Great Falls can capitalize

## eFuel and hydrogen deployment in Great Falls still face common barriers

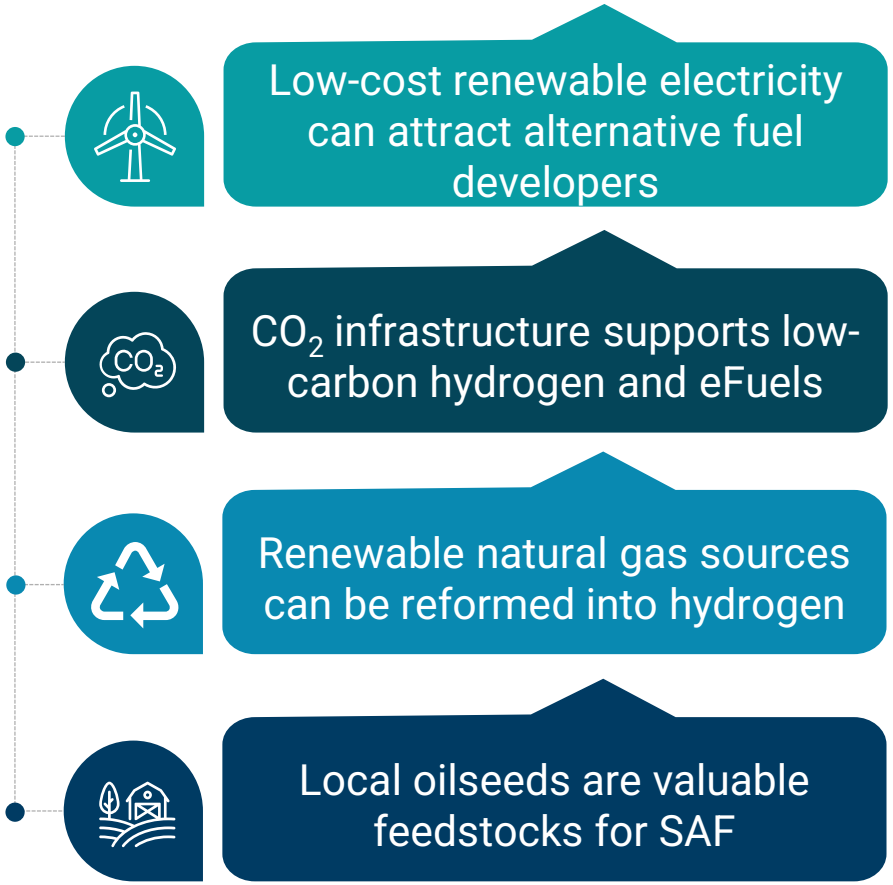
| Fuel | Resource Requirements | Challenges in Great Falls | Solutions |
|---|---|---|---|
| **Blue Hydrogen** | • Water<br>• Natural gas ($CO_2$ and heat source) | • Natural gas from Canada has a high upstream carbon impact, which is incompatible with a clean hydrogen and advanced fuels system | • Pipeline certified natural gas<br>• Inject more renewable natural gas/landfill gas into the existing pipelines |
| **Green Hydrogen** | • Water<br>• Renewable electricity<br>• Non-fossil $CO_2$ | • $CO_2$ must be from biogenic sources, which are regionally limited<br>• Or DAC, but high energy consumption is associated<br>• Hydrogen and eFuel projects can only claim credit for renewable electricity that is *additional* to the current capacity | • Tap into existing sources of biogenic $CO_2$, mineral/industrial $CO_2$<br>• Improved permitting for renewables projects, transmission infrastructure |
| **HEFA and PtL SAF** | • Biofeedstock – tallow from beef industry (Montana Premium Processing, Cargill), oils from crops (soybean, camelina, corn)<br>• Hydrogen | • Lack of local oilseed crushing infrastructure<br>• Large volumes of green or blue hydrogen | • Work with camelina value chain to deploy local crushing facilities<br>• Remove barriers to hydrogen deployment |

# Hydrogen and eFuels solution pathways

# Considerations for GFDA to fuel industry

## Early-movers in the industry can offer lessons learned, adjusted for Great Falls

**Regional Hydrogen and eFuel Development Strategy**




Incentivize new renewable electricity development and transmission for producing low-cost hydrogen

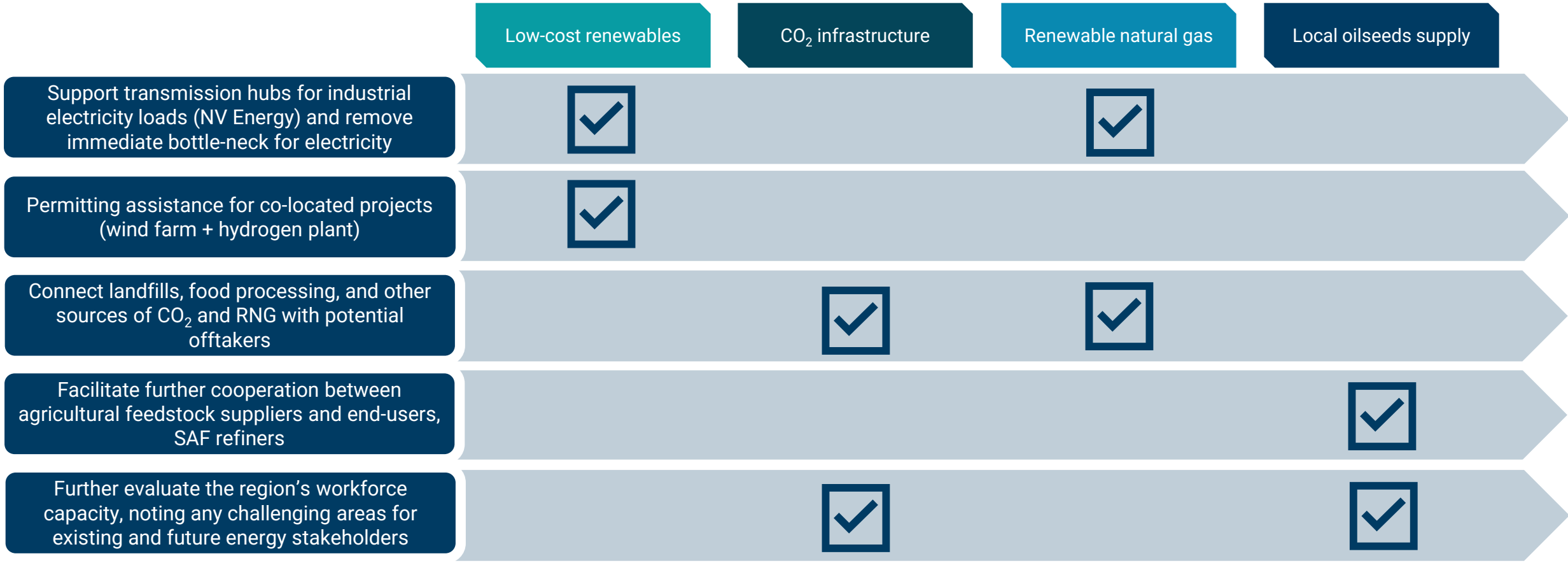
New injections to existing infrastructure will need to be identified, permitted, and constructed

Explore ways for landfills and other biomethane producers to capture and deliver their gas

Demand far outpaces supply for low-carbon oilseeds, but grower support and new crushing infrastructure can close the gap

# Short-Term Strategies

## Considerations for GFDA to support industry



# Short-Term Strategies: Next Steps

## Considerations for GFDA to support industry

| | Actions | Partnerships/stakeholders |
|---|---|---|
| Support transmission hubs for industrial electricity loads (NV Energy) and remove immediate bottle-neck for electricity | • Engage MATL transmission network for new customer redirection | • MATL partnership<br>• Northwestern Energy |
| Permitting assistance for co-located projects (wind farm + hydrogen plant) | • Explore “fast-track” process for applications that plan to co-develop alternative fuels alongside renewable electricity | • Northwestern Energy<br>• Calumet |
| Connect landfills, food processing, and other sources of $CO_2$ and RNG with potential offtakers | • Feasibility study on sources of RNG and $CO_2$<br>• Volume, accessibility, and cost of upgrades | • High Plains Sanitary Landfill<br>• US EPA Greenhouse Gas Reporting Program |
| Facilitate further cooperation between agricultural feedstock suppliers and end-users, SAF refiners | • Sub-working group between stakeholders<br>• Analysis on infrastructure needs, synergies between stakeholders | • Montana Renewables<br>• Sustainable Oils<br>• University of Montana |
| Further evaluate the region’s workforce capacity, noting any challenging areas for existing and future energy stakeholders | • Analysis on labor needs, connecting training programs with areas experiencing current or projected shortages | • Montana Renewables<br>• Sustainable Oils<br>• University of Montana |

# Long-Term Strategies

## Considerations for GFDA to support industry

| | Low-cost renewables | $CO_2$ infrastructure | Renewable natural gas | Local oilseeds supply |
|---|---|---|---|---|
| Co-develop integrated resource plans (IRPs) alongside utilities and a coalition of industry | ✓ | | ✓ | |
| Expand to a statewide coalition of electricity stakeholders to accelerate transmission deployment | ✓ | | ✓ | |
| Permitting easements for behind-the-meter renewable electricity projects as more refineries build their own energy supplies | ✓ | | ✓ | |
| Undertake a geological siting analysis to show industry the potential for carbon capture projects to co-locate with refineries | | ✓ | | ✓ |
| Support local oilseed crushing and other key infrastructure to accelerate uptake of regional camelina growth | | | | ✓ |

# Long-Term Strategies: Next Steps

## Considerations for GFDA to support industry

| | Actions | Partnerships/stakeholders |
|---|---|---|
| Co-develop integrated resource plans (IRPs) alongside utilities and a coalition of industry | • Collective development plans from large industry<br>• IRPs to account for expanded use of renewable electricity, including behind-the-meter stations | • Northwestern Energy<br>• Great Falls Chamber of Commerce<br>• Montana Renewables |
| Expand to a statewide coalition of electricity stakeholders to accelerate transmission deployment | • Engage statewide stakeholders to align with “bigger picture” infrastructure that would support larger industrial networks | • Northwestern Energy<br>• Other utilities |
| Permitting easements for behind-the-meter renewable electricity projects as more refineries build their own energy supplies | • Cooperate with utilities to understand any bottlenecks that could slow the uptake of energy to new industry<br>• Incentivize a market for behind-the-meter generation | • Northwestern Energy |
| Undertake a geological siting analysis to show industry the potential for carbon capture projects to co-locate with refineries | • Fund or co-develop a siting analysis for wells that fit the EPA standards for sequestration<br>• Sponsor an accelerator for carbon capture companies | • University of Montana<br>• US Geological Survey<br>• Carbon capture startups |
| Support local oilseed crushing and other key infrastructure to accelerate uptake of regional camelina growth | • Find or create financing mechanisms (grants, loans, eased siting, etc) to fill identified infrastructure gaps<br>• Advocate a state production tax credit for local biofuels | • Montana Renewables<br>• Sustainable Oils<br>• Montana State Legislature |

# Thank you!