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Bio-Based Diesel: Today's Most Impactful Option for GHG Reduction and Sustainable Transportation

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Renewable Energy Group

Discussion Points

- Renewable Energy Group at a glance
- Time value of GHG reductions
- Market feedback and choices for bio-based diesel
- Renewable diesel and biodiesel are better together
- Concluding remarks

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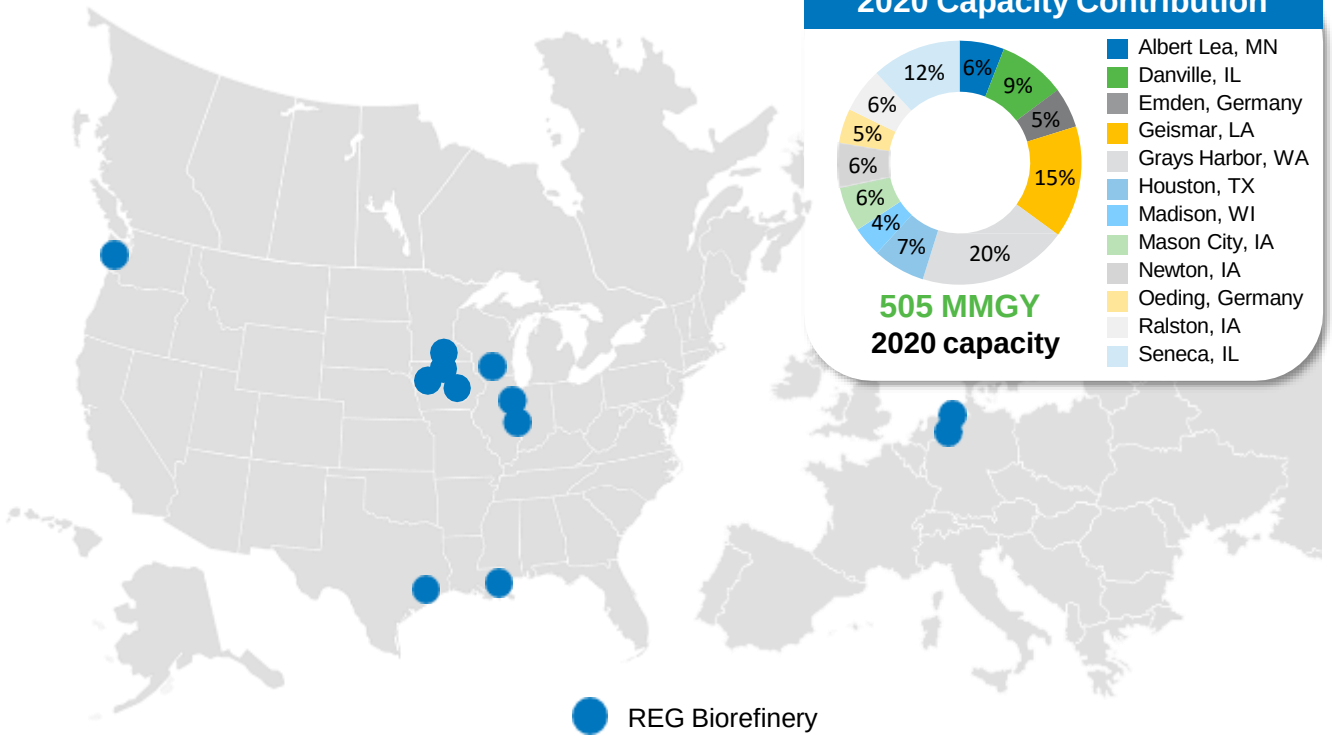
Diversified footprint of biorefineries enables optimization

12 Bio-Based Diesel Plants | **651**[(1)] Million Gallons Sold in 2020 | REG 2020 Sales were made in: **41** U.S. States, **7** Canadian Provinces, **14** Countries

- **Global reach with diversified end-market exposure**
- **Integrated model with optimized feedstock and distribution networks**
- **Flexibility and sales optimization to incentivized markets**
- **Proven access to diversified feedstocks**



2020 Capacity Contribution

505 MMGY
2020 capacity

Source: Company
(1) Includes self-produced and third-party bio-based diesel and petroleum-based diesel.

Reducing carbon at scale

4.2 MILLION METRIC TONS

OF CARBON REDUCTION[1]

FROM 519 MILLION GALLONS OF BIOFUELS PRODUCED IN 2020

EQUIVALENT TO

GHG EMISSIONS FROM

10.4 BILLION MILES

DRIVEN BY AN AVERAGE PASSENGER VEHICLE[2]

CO_2 EMISSIONS FROM

4.6 BILLION POUNDS

OF COAL BURNED[2]

CO_2 SEQUESTERED BY

5.5 MILLION ACRES

OF U.S. FORESTS IN ONE YEAR[2]

CO_2 EMISSION REDUCTION FROM

1.7 MILLION

PASSENGER ELECTRIC VEHICLES ON THE ROAD IN ONE YEAR[3]

(1) Carbon reduction based on life cycle analysis of REG-produced fuels versus petroleum diesel.
(2) epa.gov/energy/greenhouse-gas-equivalencies-calculator
(3) Assuming annual travel of 11,484 miles/year and national grid average electricity versus gasoline using CA-GREET

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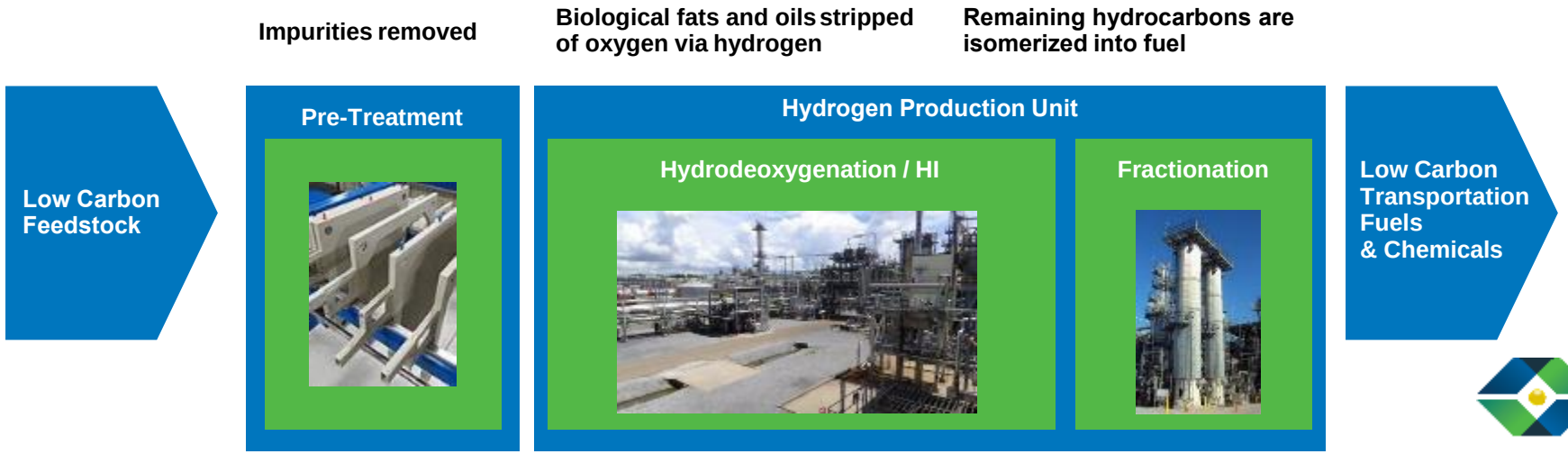
REG Geismar improvement and expansion project overview

- Expected additional capacity: 250 million gallons per year
- Total resulting capacity: 340 million gallons per year
- On track for mechanical completion in 2023, full rates anticipated in 2024
- REG's capital cost is currently estimated to be $950 million, fully financed
- Project now includes planned expansion and an improvement project for the existing site

REG SynFining® Technology & Process Overview



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The urgency of reducing GHG emissions ASAP

- Scientists warned that there would be more frequent severe weather events and that they would increase in intensity
  - Unfortunately we are seeing that manifest with tragic consequences
- Many environmental scientists consider this decade to be critical for climate change mitigation
  - Many entities treat “2030” as a target date by which to achieve an annual GHG reduction target
  - Yet in setting these targets, they have frequently failed to appreciate or prioritize the importance of reducing GHG emissions sooner rather than later

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What is “Cumulative Carbon Impact”?

- Cumulative Carbon Impact can be estimated for any activity that generates fossil carbon emissions
  - Analogous to how we save for retirement
  - Except emission reductions are the currency
- The Cumulative Carbon Impact for fossil carbon emissions is determined by both the size of the emissions AND when they occur
  - Like retirement investing because the earlier an emissions behavior is changed, the more years that change has to make a difference
    - → Similar to annual deposits in a retirement account
  - But also because greenhouse gases persist in the atmosphere
    - → Similar to compounded interest on annual deposits
    - → Each year’s emissions continue to have a negative impact for many years, which means emissions reductions have a multi-year benefit

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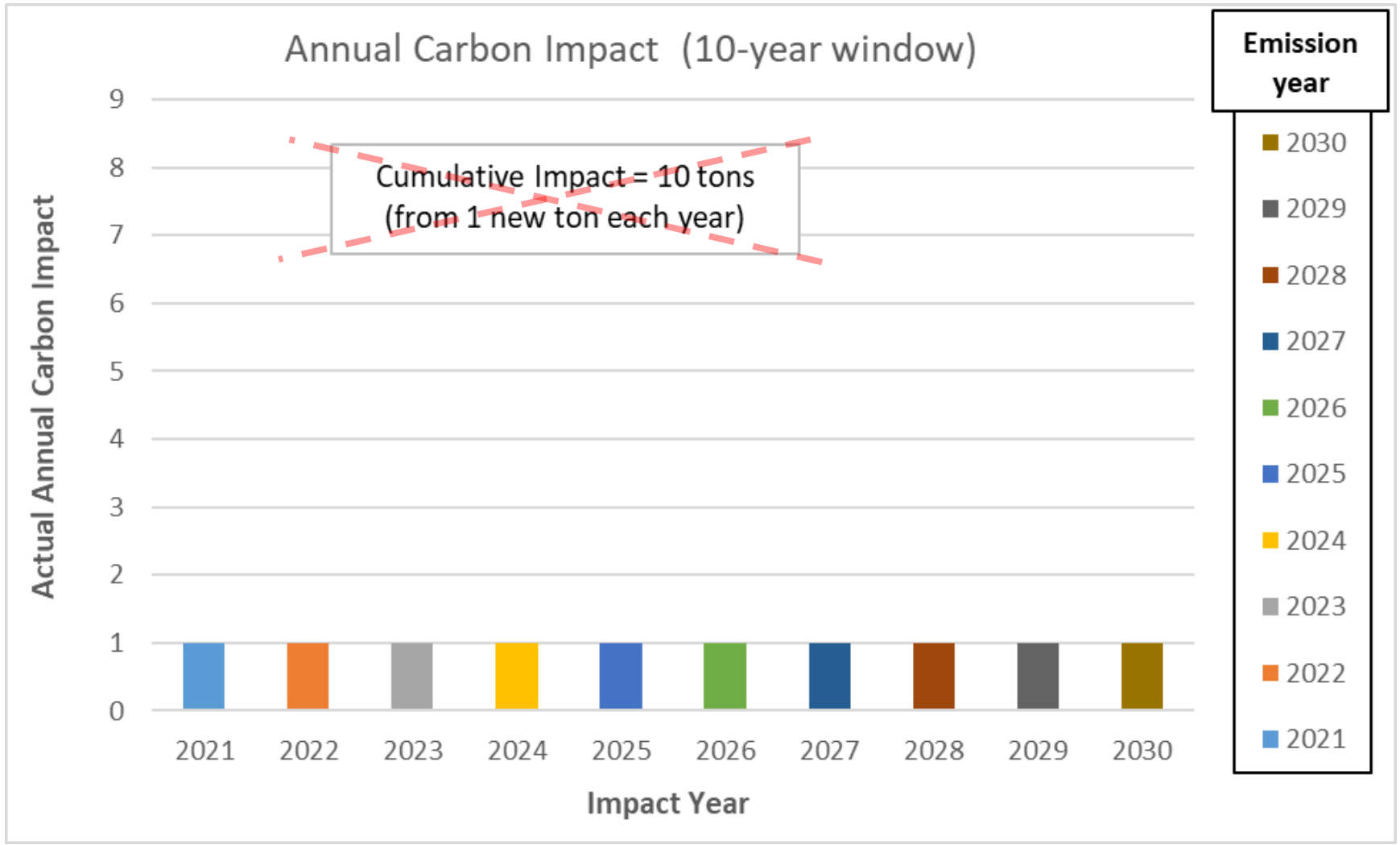
Simple addition of annual carbon emissions is misleading



TAKEAWAYS

- **FALSE**: Fossil carbon emissions affect the atmosphere only in the year it was emitted
- **FALSE**: The sum of annual fossil carbon emissions reflects their actual impact on the environment

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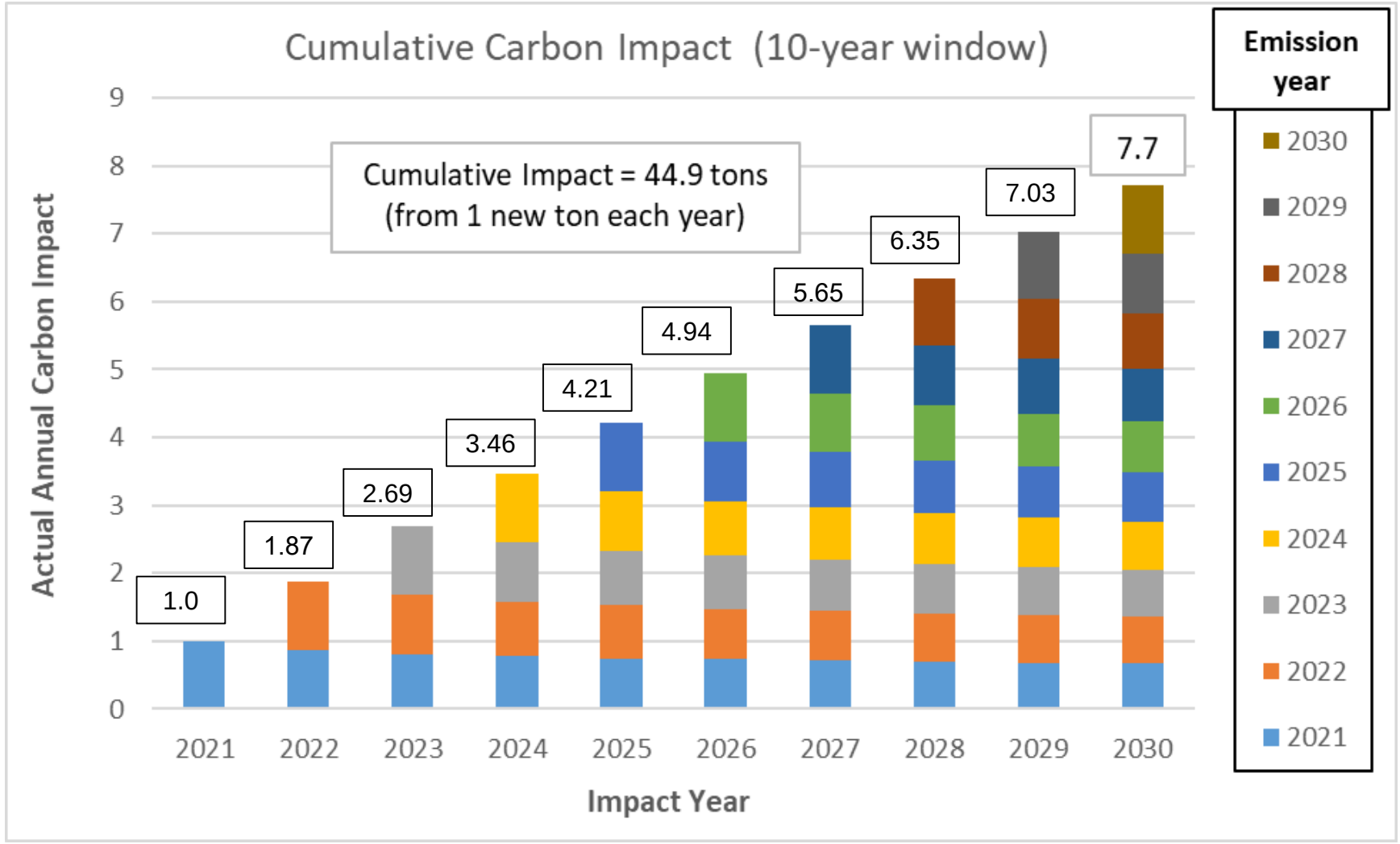
Accounting for Cumulative Carbon Impact is more accurate



TAKEAWAYS

- New carbon impacts the atmosphere each year for many years (new carbon = fossil carbon)
- 7.7 tons of new (fossil) carbon in the atmosphere in 2030 (as CO_2)

* Using the Bern Carbon Cycle model provided in Ch. 10 of the 4th Assessment Report of the IPCC (2007) from Joos et al., 2001.

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Cumulative Carbon Impact and Cumulative Benefit

Unlike simple annual accounting, cumulative impact accounting for fossil carbon emissions reflects their actual real-world impact over the time period of interest

- Cumulative Carbon Impact = the total of the actual annual fossil carbon impacts over the time period of interest
- Cumulative Benefit = the decrease in Cumulative Carbon Impact relative to a baseline case (i.e., the status quo)
  - Baseline case (previous slide) is 44.9 tons of Cumulative Carbon Impact from 2021 – 2030
  - The next slides depict changes from the base case:
    - Case 1: Implementing a zero-fossil carbon option in 2026; for this case, the Cumulative Carbon Impact from 2021 – 2030 is 31.67 tons; So, its Cumulative Benefit by 2030 = (44.9 – 31.67) / 44.9 = **29.6%**
    - Case 2: Starting with a modest 20% penetration of BBD (with 80% CI reduction) increasing to 50% penetration by 2025; for this case, the Cumulative Carbon Impact from 2021 – 2030 is 30.42 tons; So, its Cumulative Benefit by 2030 = (44.9 – 30.42) / 44.9 = **32.2%**
    - Case 3: Starting with 50% penetration of BBD in 2021; for this case, the Cumulative Carbon Impact from 2021 – 2030 is 26.94 tons; So, its Cumulative Benefit by 2030 = (44.9 – 26.94) / 44.9 = **40%**

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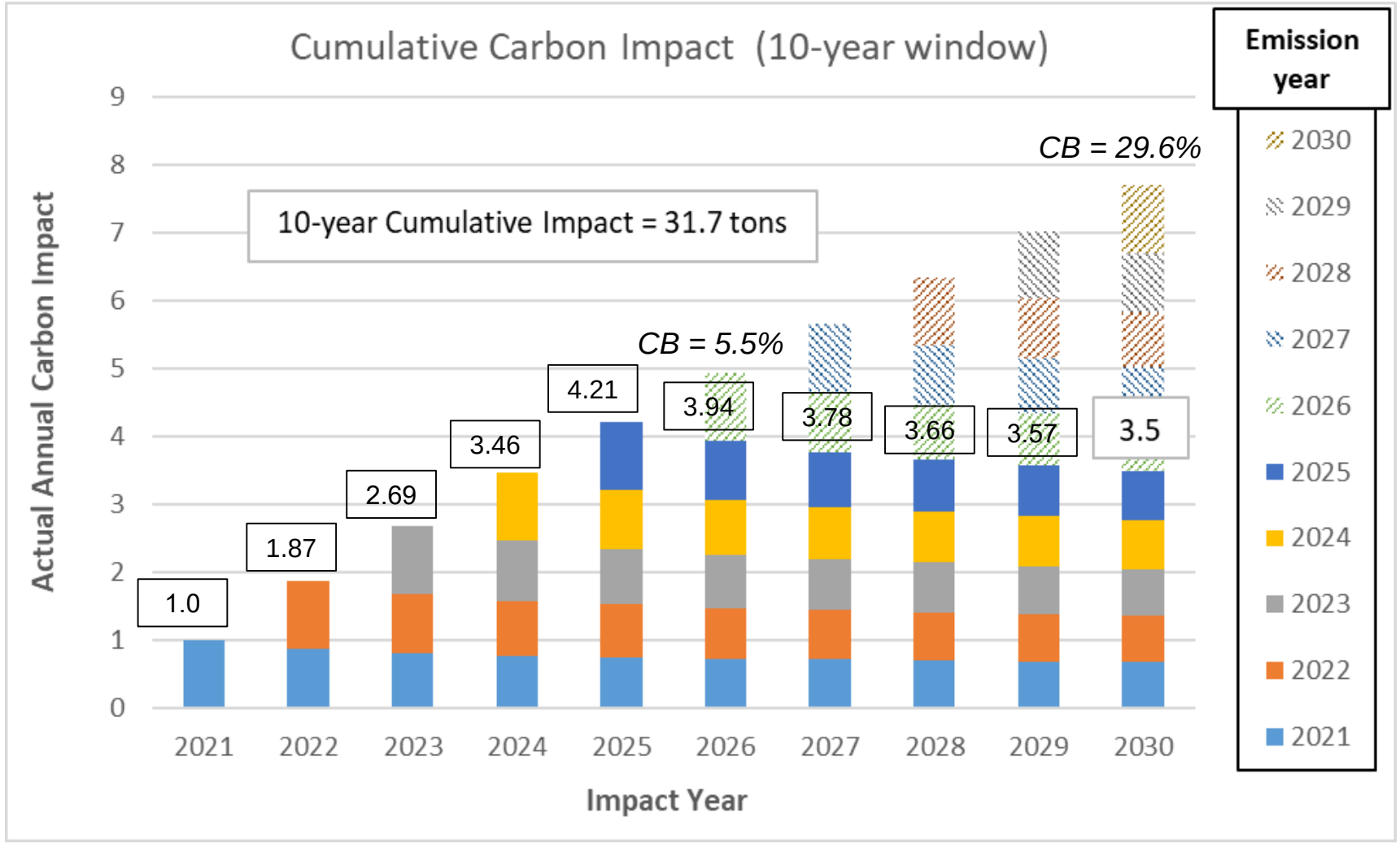
Carbon Impact of zero-carbon fossil emissions starting in 2026

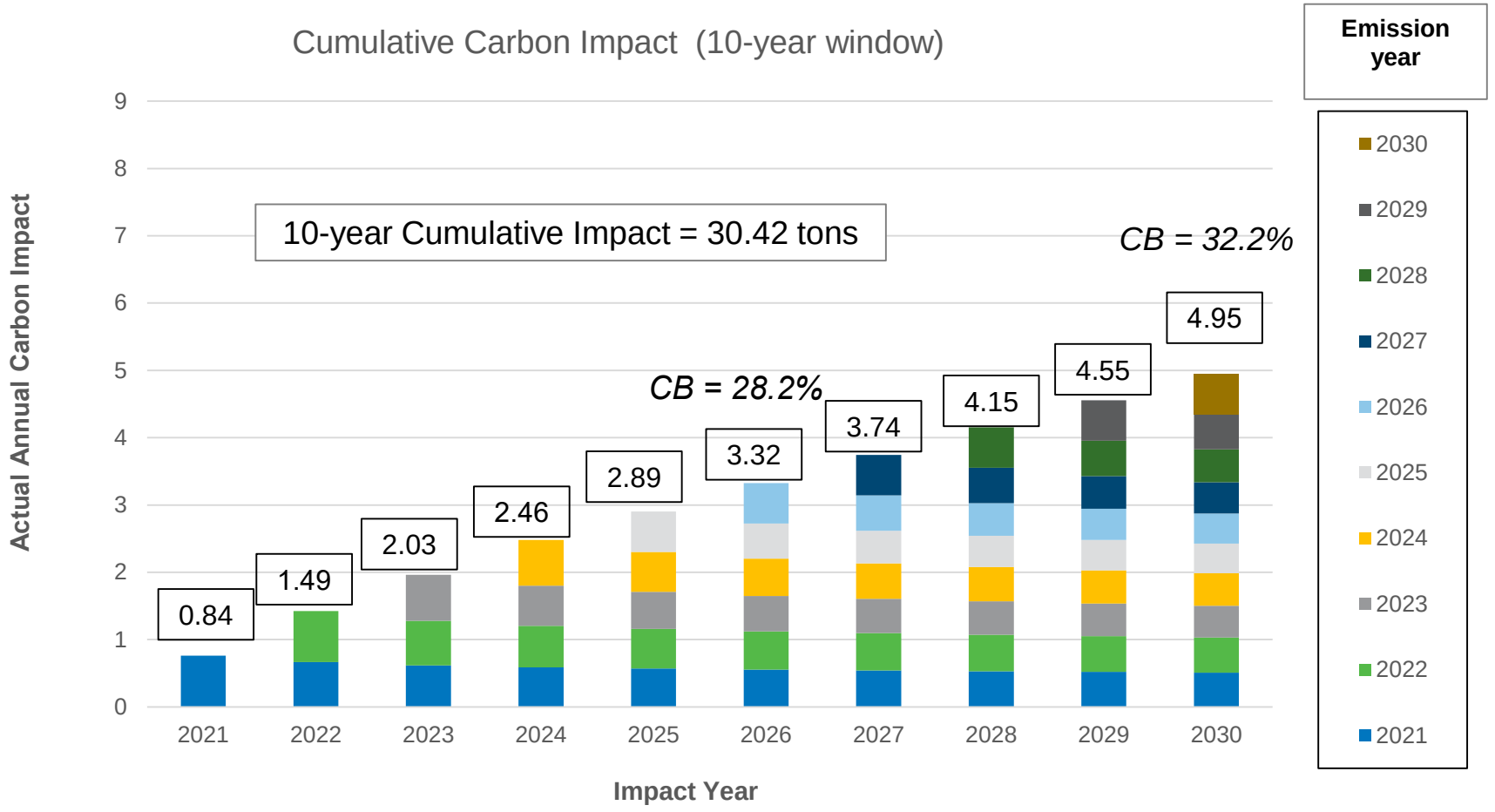


TAKEAWAYS

- No benefit until 2026 (neither cumulative nor annual)
- Significant residual fossil carbon remains in 2030 (3.5 tons)
- 5.5% Cumulative Benefit by 2026; increases to 29% by 2030

* Using the Bern Carbon Cycle model provided in Ch. 10 of the 4th Assessment Report of the IPCC (2007) from Joos et al., 2001.

Impact of 20% BBD usage in 2021; increasing to 50% in 2024



TAKEAWAYS

- Assumes increase in BBD usage from 20% to 50% (with 80% GHG reduction)
- Early reduction, even if small, contributes to cumulative benefit
- 28.2% Cumulative Benefit by 2026; increases to 32.2% by 2030

* Using the Bern Carbon Cycle model provided in Ch. 10 of the 4th Assessment Report of the IPCC (2007) from Joos et al., 2001.

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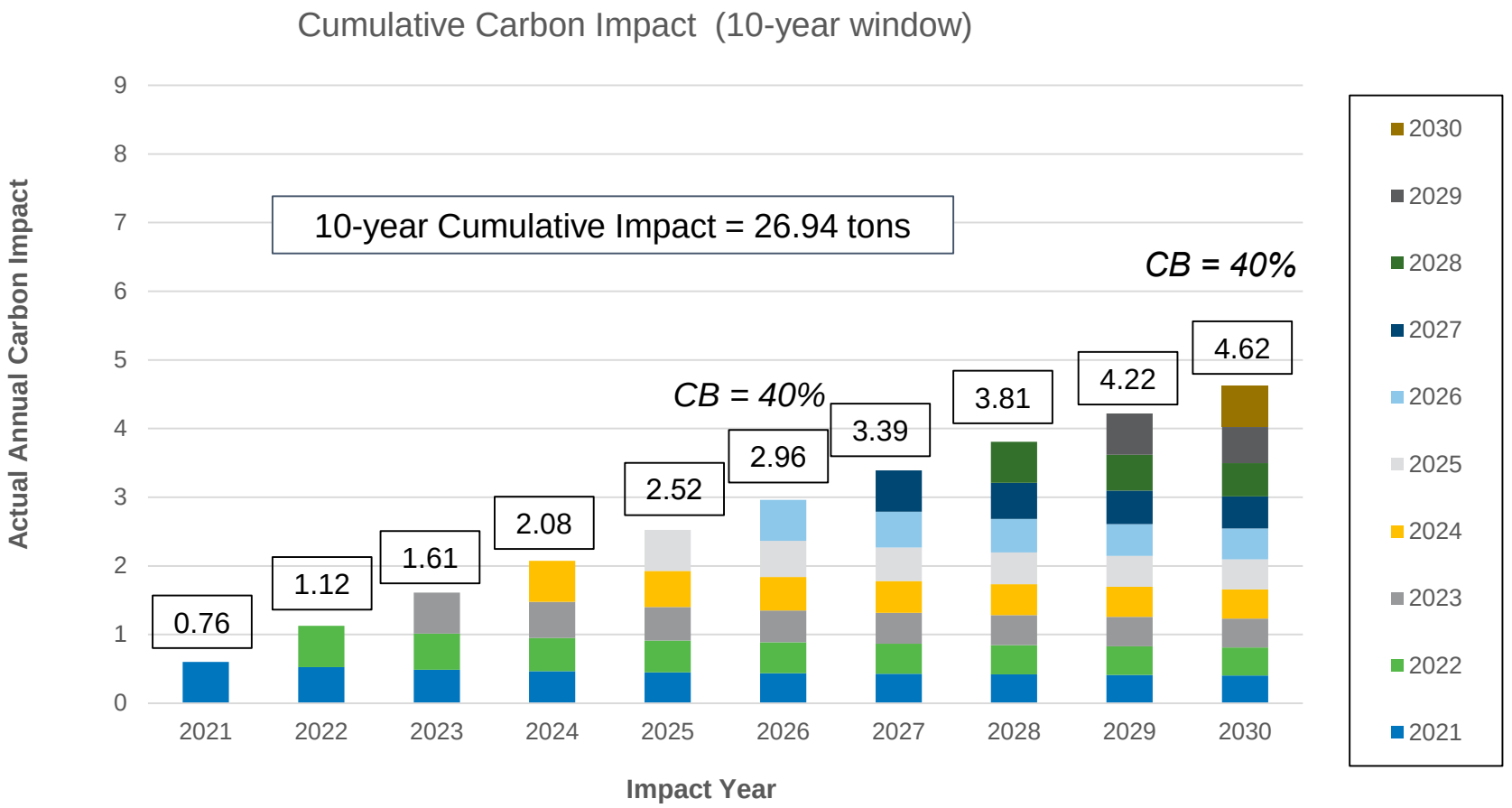
Impact of 50% BBD usage starting in 2021



TAKEAWAYS

- Assumes BBD usage at 50% in 2021 (with 80% GHG reduction)
- Early reduction greatly contributes to cumulative benefit
- 40% Cumulative Benefit in every year

* Using the Bern Carbon Cycle model provided in Ch. 10 of the 4th Assessment Report of the IPCC (2007) from Joos et al., 2001.

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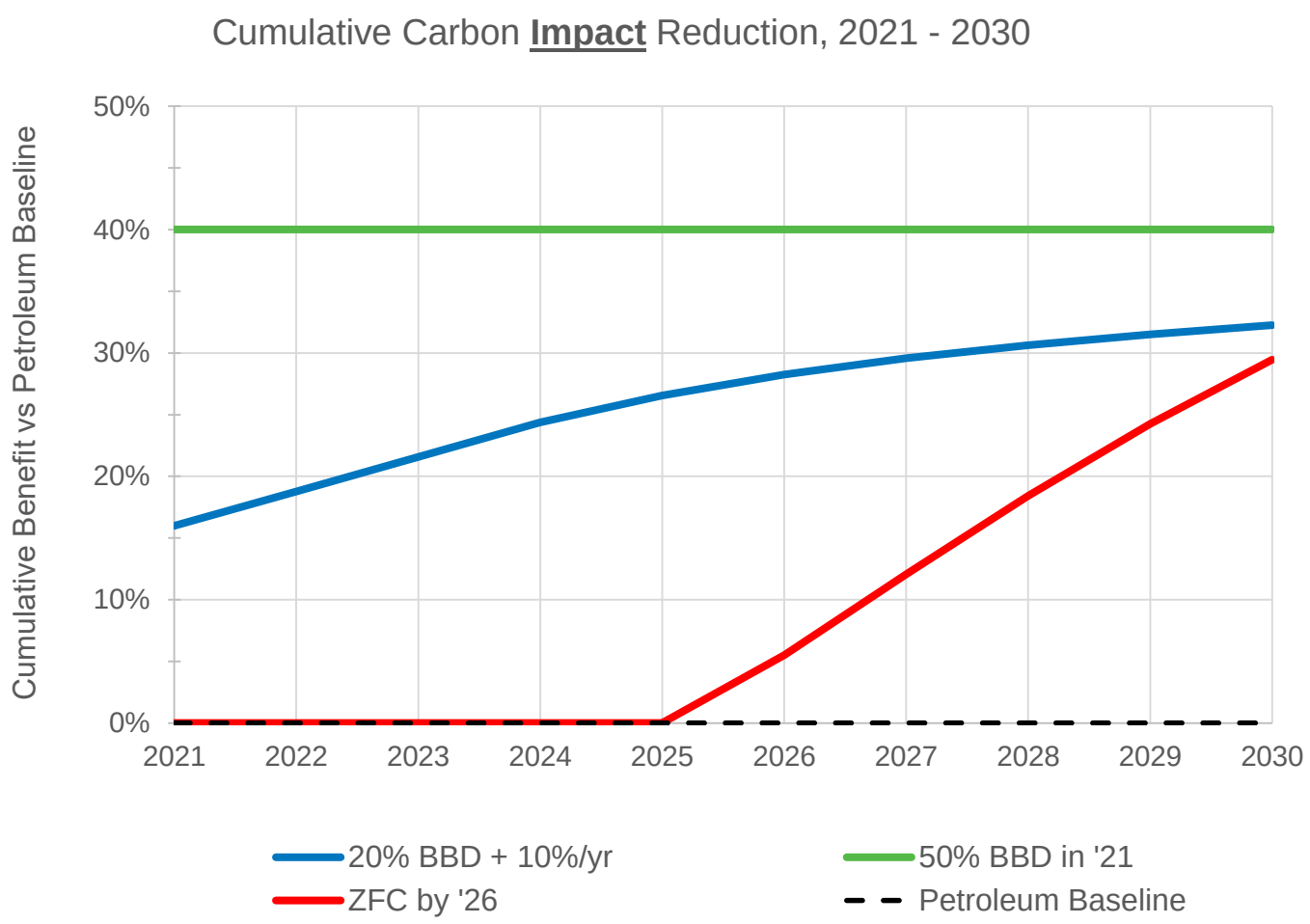
Comparison of Carbon Impacts from the three cases



TAKEAWAYS

- High BBD can greatly reduce our Cumulative Carbon Impact the most over the next 10 years.

Source: Chart assumes 80% fossil carbon reduction for BBD, and 100% reduction for the ZFC

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Market is demanding high-performing, low-carbon fuels NOW!

Goal is to reduce fossil carbon emissions as much as possible, as quickly as possible

Industry must support low-carbon fuel options demanded to meet fuel user needs

- Failure to support currently available lower-carbon alternative stalls our collective effort to reduce fossil carbon emissions
- Lack of support limits customer choices and perpetuates the status quo of higher than needed GHG emissions

Providing clear support for higher bio-based diesel blends enables consumer choices, which allows market forces to successfully reduce fossil carbon emissions immediately

- Renewable diesel and biodiesel are available in significant supply now

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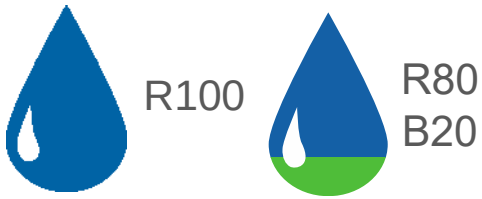
Consumers want to reduce GHGs – and have other needs

Customer 1

NEEDS:

100% BBD;
low cloud point, U.S. west coast

SOLUTION:



Customer 2

NEEDS:

100% BBD;
price sensitive, wide geography, large supply

SOLUTION:

Customer 3

NEEDS:

100% BBD;
price sensitive, wide geography, large supply, some limitations on usage

SOLUTION:

Customer 4

NEEDS:

40% BBD;
price sensitive; low cloud point, wide geography, large supply

SOLUTION:

Customer 5

NEEDS:

≥ 20% BBD;
price sensitive; wide geography, large supply

SOLUTION:

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Renewable diesel and biodiesel offer benefits when blended together

- Renewable Diesel (RD) is a paraffinic fuel with:
  - Reduced engine emissions (NOx, in particular, and also particulate matter and hydrocarbons)
  - Exceptional cetane number
- Biodiesel (BD) is an oxygenated fuel with:
  - Reduced engine emissions (particulate matter and hydrocarbons, in particular)
  - Exceptional lubricity
- Blends have beneficial properties compared to using either fuel alone (i.e., complementary benefits)
  - RD provides NOx reduction & high cetane
  - BD provides particulate reduction, density, elastomer swell, and lubricity
- A 50:50 blend of BD and RD is most similar to petroleum diesel in fluid properties
  - And has the lowest overall engine emissions

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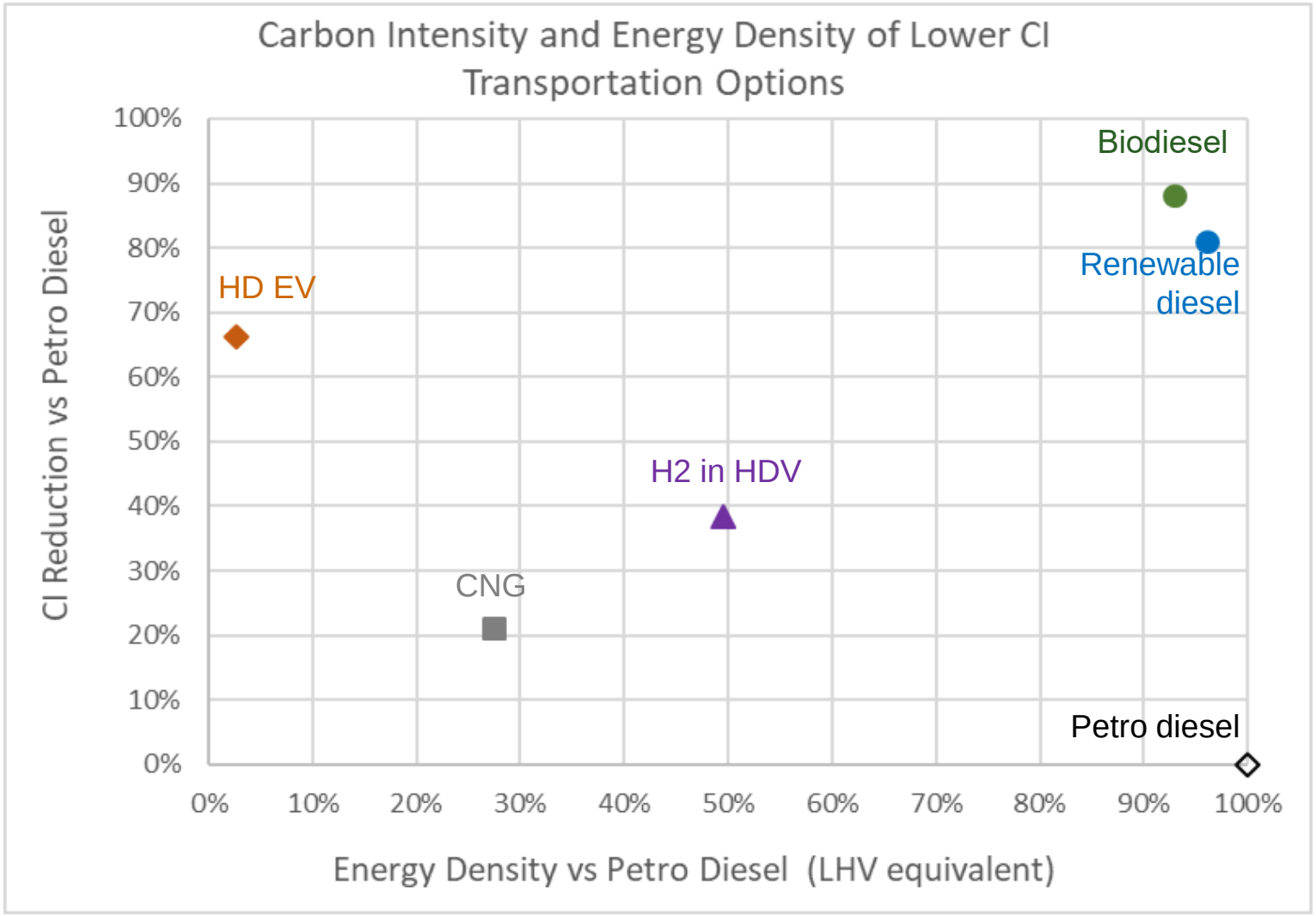
Bio-based diesels demonstrate very good GHG reduction and excellent energy density



Assumptions:

1. All estimates based on CA-GREET version 3.0 and REG's CA LCFS registrations for BD and RD
2. Hydrogen derived from natural gas via SMR and pressurized to 5,000 psi (35 MPa)
3. CNG is natural gas pressurized to 3,600 psi
4. Heavy-duty EV assumes electricity with the 2019 U.S. grid average CI, an EER of 5.0, and battery volume (i.e., physical size) of 1 gallon per kWh capacity

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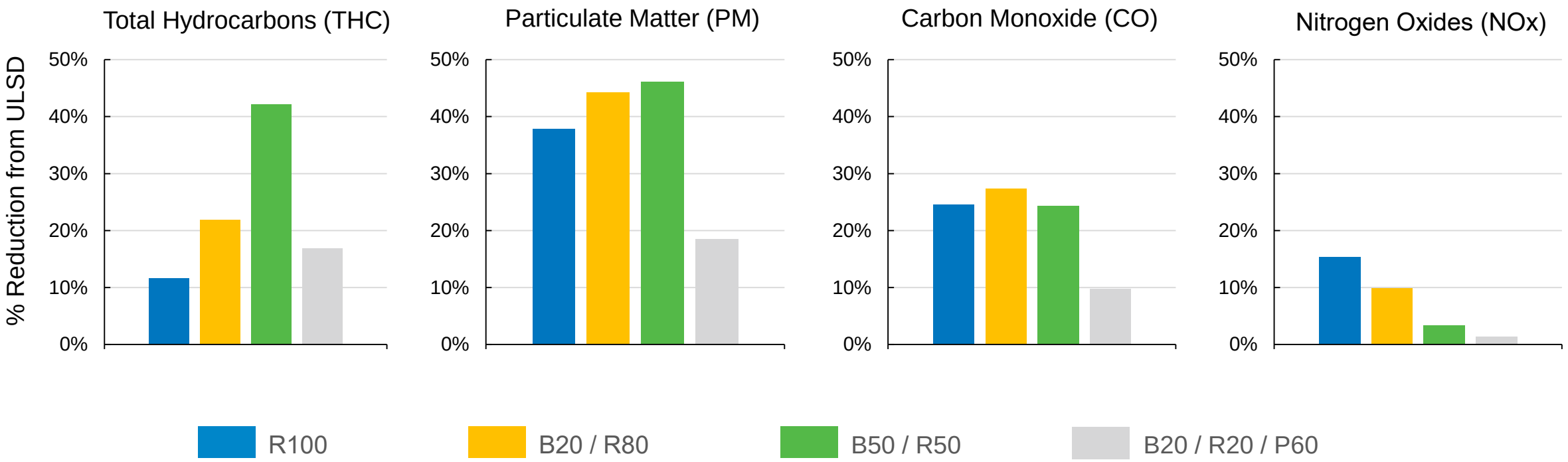
RD/BD blends offer lower engine out emissions



Source: REG charts based on California Air Resources Board assessments compared to federal ULSD

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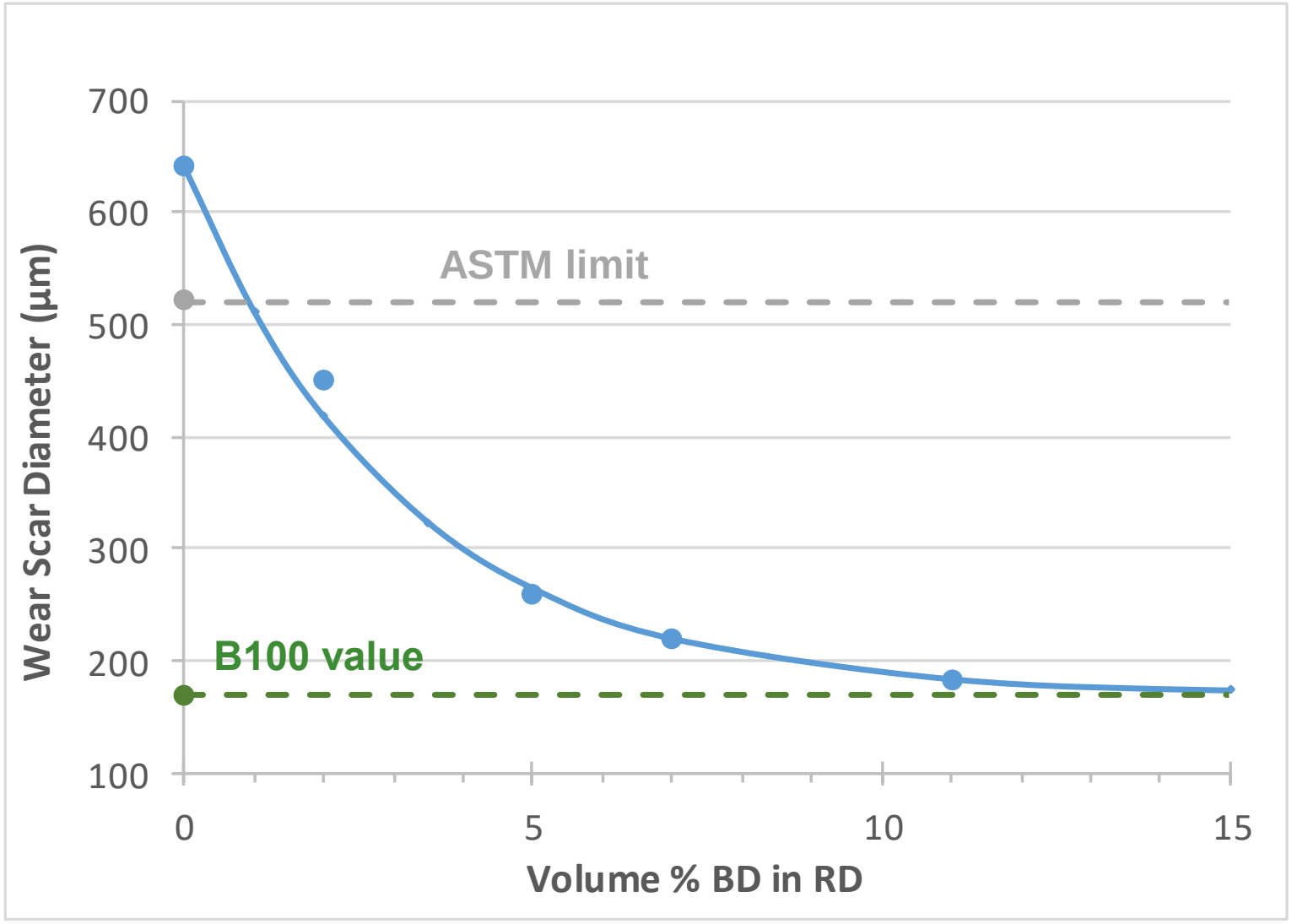
RD/BD blends are easier on engines

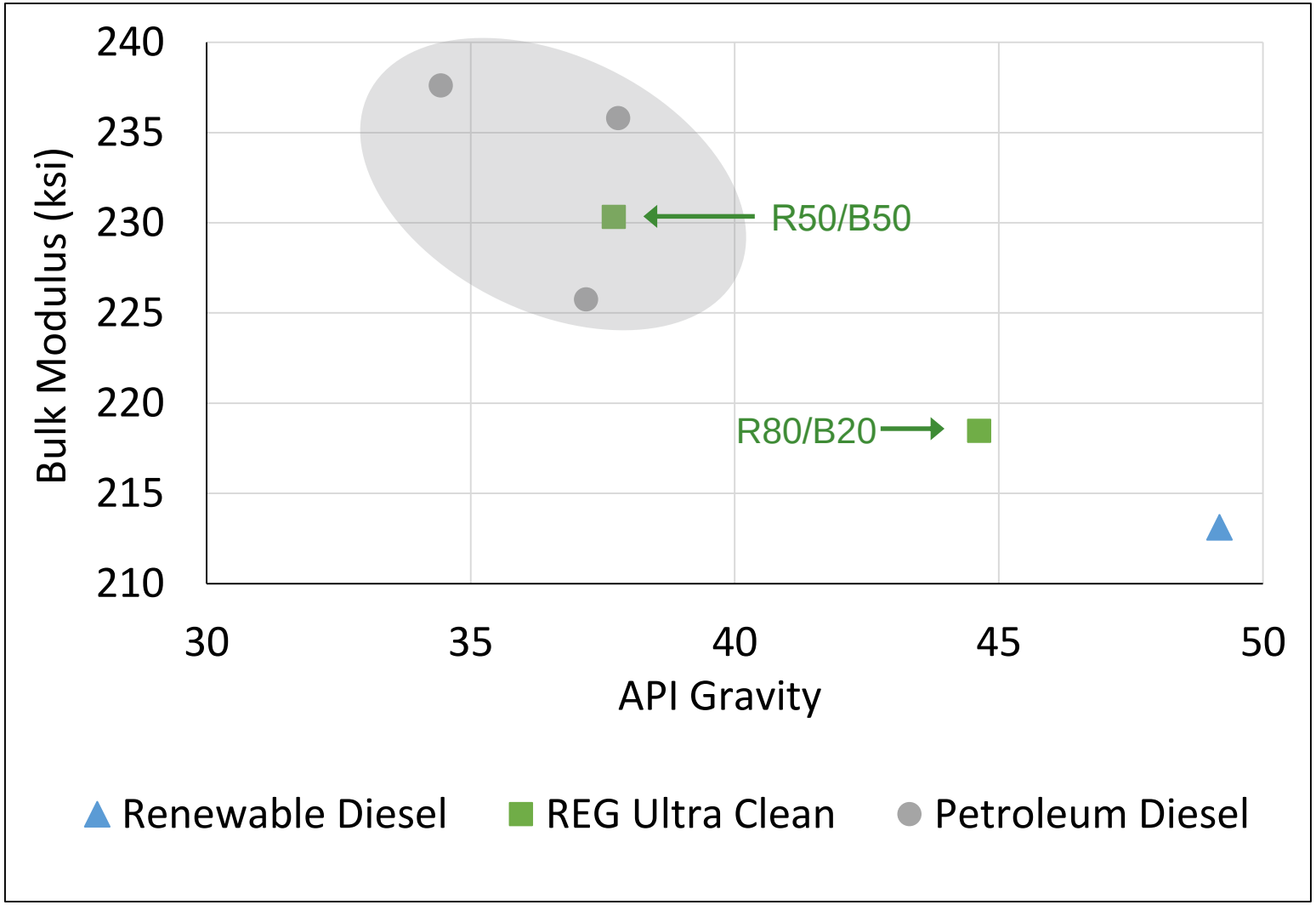
- More lubricity = less wear on engine parts and fuel pumps
- Biodiesel provides excellent lubricity
  - More BD = less wear
  - No need for petroleum additives with 2% BD



Source: REG data

RD/BD blends are close to conventional diesel in bulk properties

- Bulk modulus and API gravity provide information about fluid behavior in an engine
- BD/RD blends have fluid properties similar to petroleum diesel



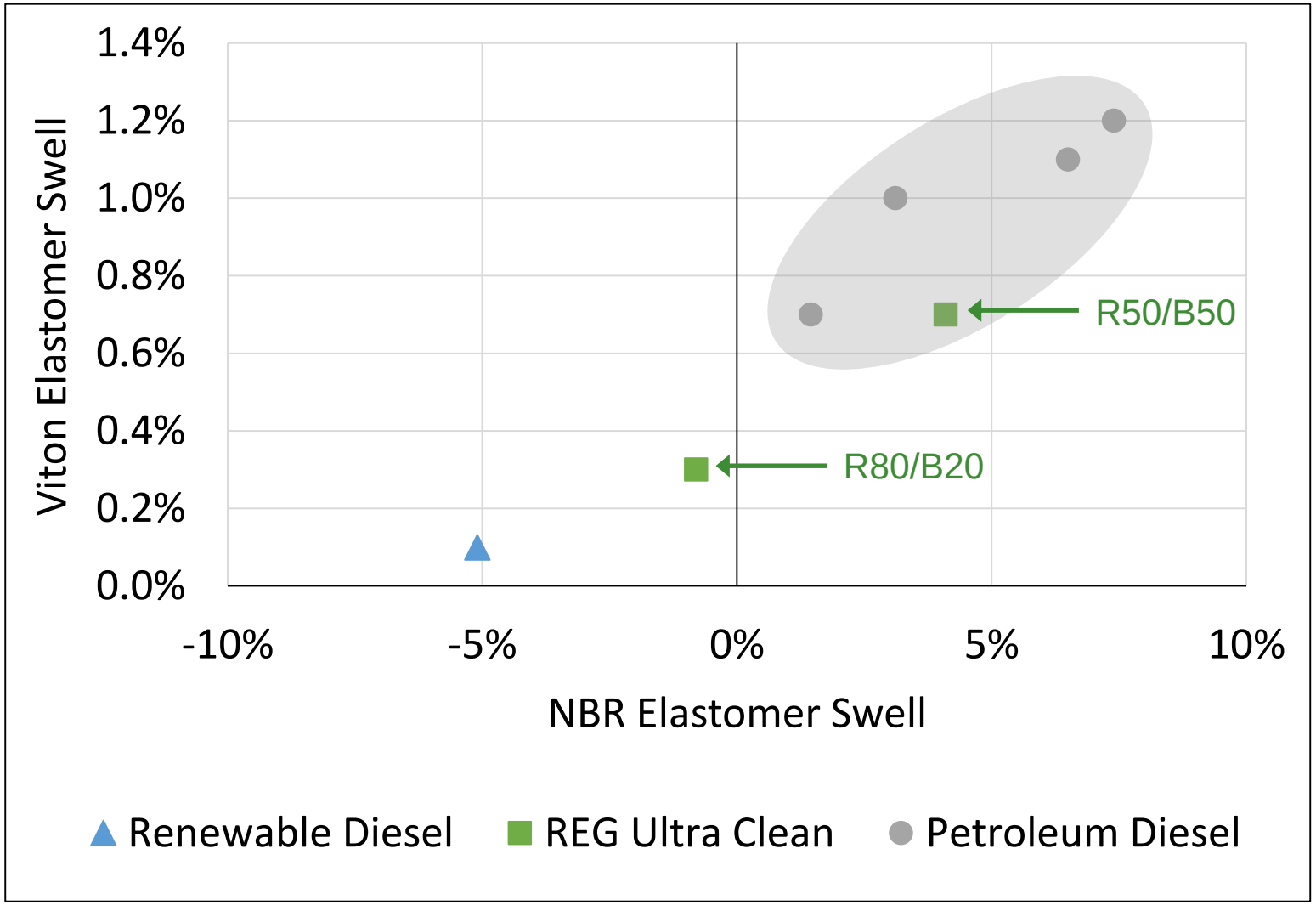
Source: REG data

RD/BD blends work well with old and new equipment

Elastomer swell is another important fuel property for reliable engine function

Blends of RD and BD better match the elastomer swell expected with petroleum diesel

- NBR is more common in legacy engines
- Viton is commonly used in new technology engines



Source: REG data

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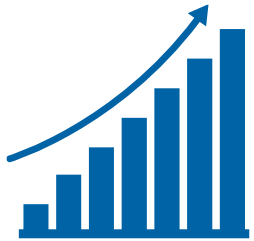
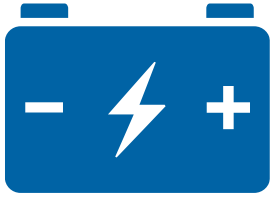
Transportation is a major contributor to GHG emissions.



GHGs accumulate in the atmosphere.



Waiting for future technologies to deliver a perfect GHG reduction solution is counter productive.

Renewable diesel and biodiesel provide excellent solutions TODAY. Support is needed to maximize usage.

Renewable diesel and biodiesel are complementary low-carbon, clean burning, high-performing fuels which can be used synergistically.

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Thank you.

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