

April 2022

Net-Zero Transportation

Fuel and electrification strategies:
Both are necessary to achieve mid-century
decarbonization goals



Fuel will still be used in 2050

“Critical applications will be difficult or impossible to electrify by 2050.”¹

National Academies of Science

Transportation



Industry



Energy Storage and Firm Power



Climate experts agree...

Support for these [fuel decarbonization] technologies today, through research and development, early-stage commercialization, and ultimately large-scale deployment, is necessary to achieve net-zero emissions.

Environmental Defense Fund, Marginal Abatement Cost Curves for U.S. Net-Zero Energy Systems

To decarbonize the transportation sector, it is crucial that the energy sources – electricity and liquid or gaseous fuels – powering vehicles be produced in a very low-carbon or carbon-neutral way.

ICCT, Vision 2050

Countries that incorporate renewable energy carriers such as biofuels, e-fuels, renewable electricity, and renewable hydrogen have the best chances to meet decarbonization goals.

IEA, Net-Zero by 2050

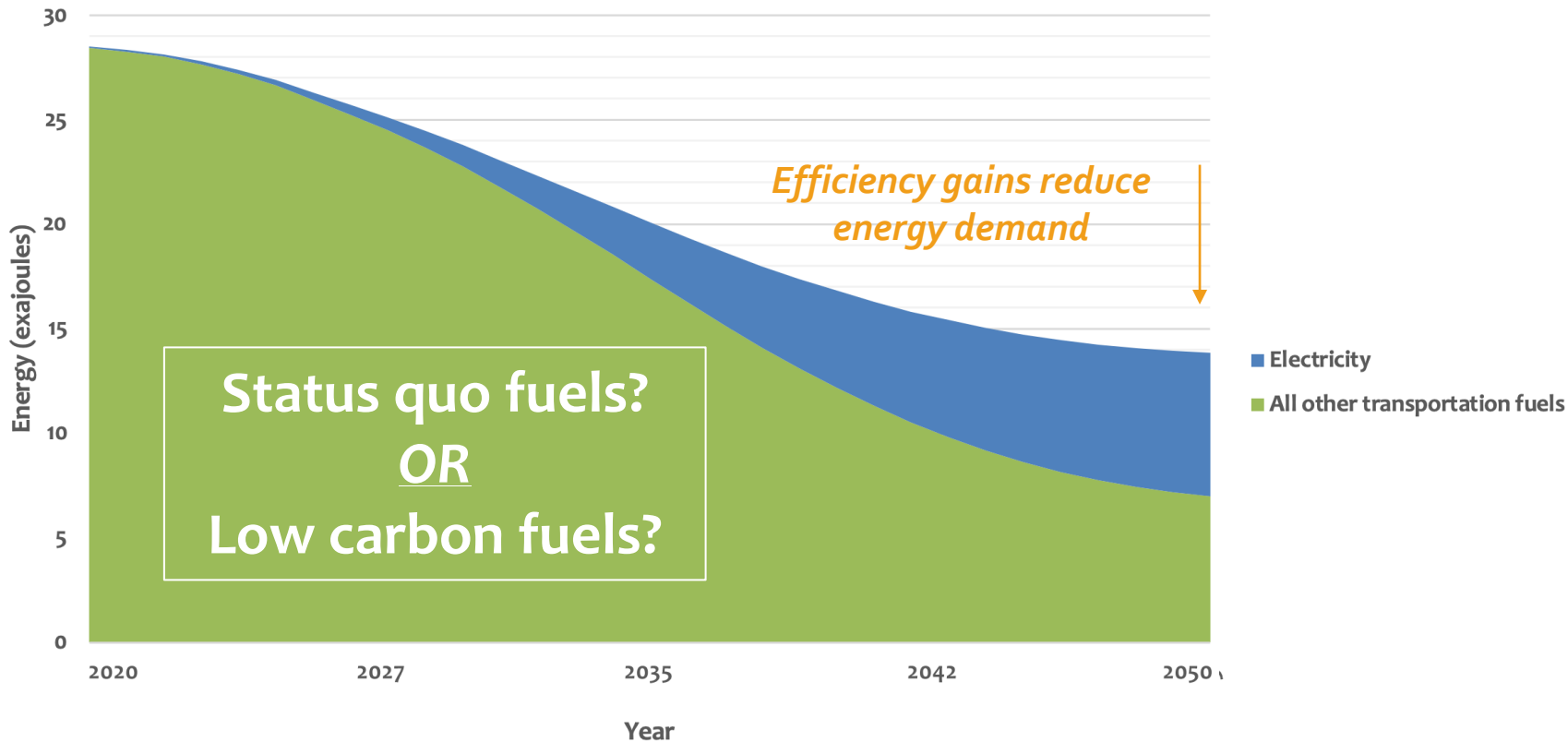
Climate experts agree...

Net-zero energy systems will need to rely on alternative fuels – notably hydrogen or biofuels – in several sectors that are not amenable to electricity and otherwise hard to decarbonize.

ICCP, Working Group III, AR 6 (Mar. 2022)

Net zero fuels are essential

Energy Sources for Transportation



2 billion

*new ICE vehicles
expected on the road
by 2050*

ICCT, Vision 2050

Mid-Century Fuels Project, using data from UC Davis and the U.N.

In 2050, marine and aviation emissions could exceed US + China

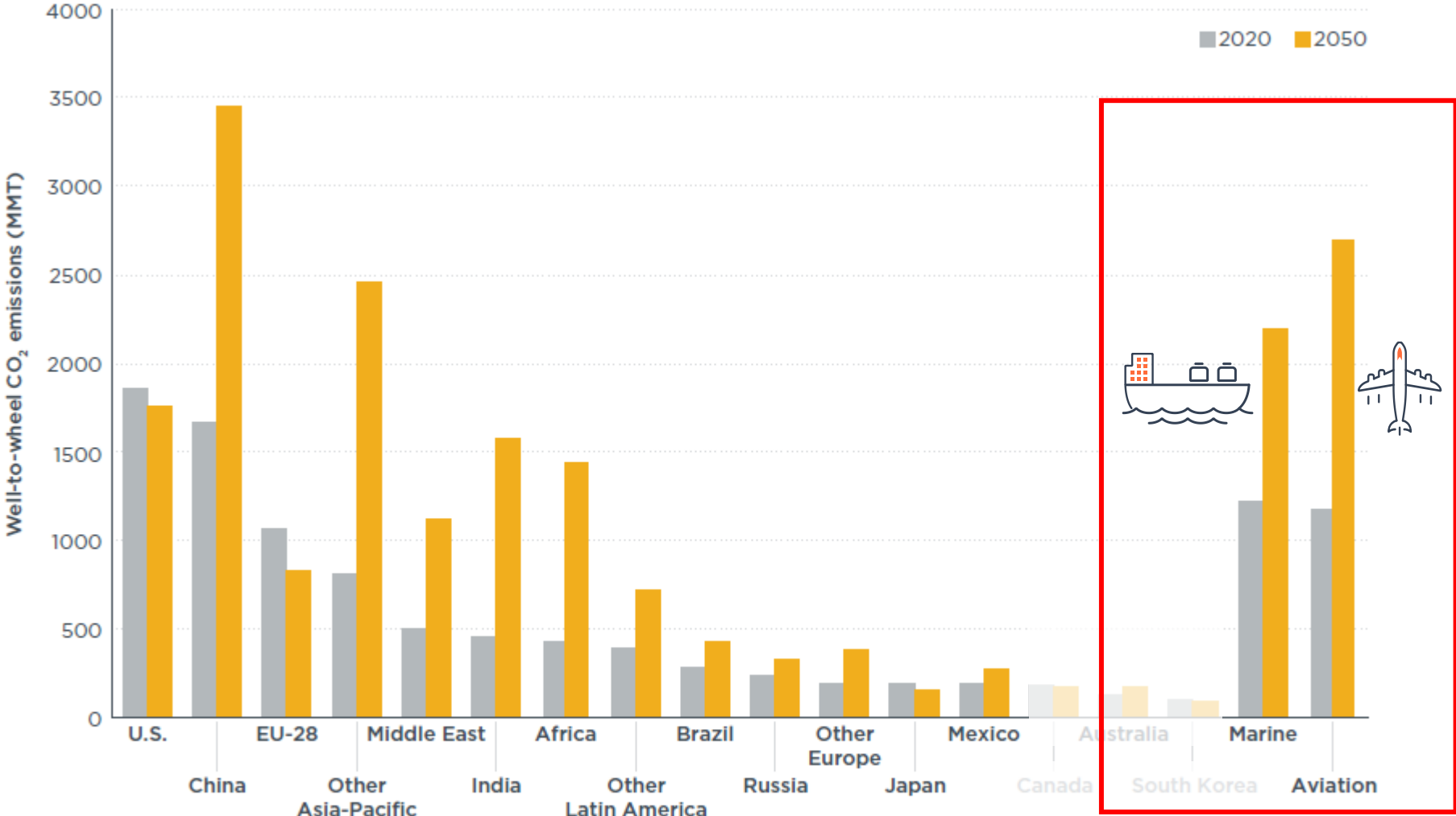


Figure 4. Transportation CO₂ emissions by region, with global aviation and marine sectors, in 2020 and 2050.

Low carbon fuels are available – and more are coming

Approaches include...



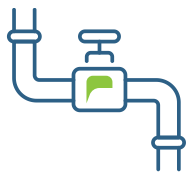
Hydrogen

- Water (electrolysis)
- Renewable Natural Gas
- Using renewable energy and CCUS



Renewable Natural Gas (RNG)

- Produced from wastes or biomass
- Used as net-zero fuel
- Used for H₂ production

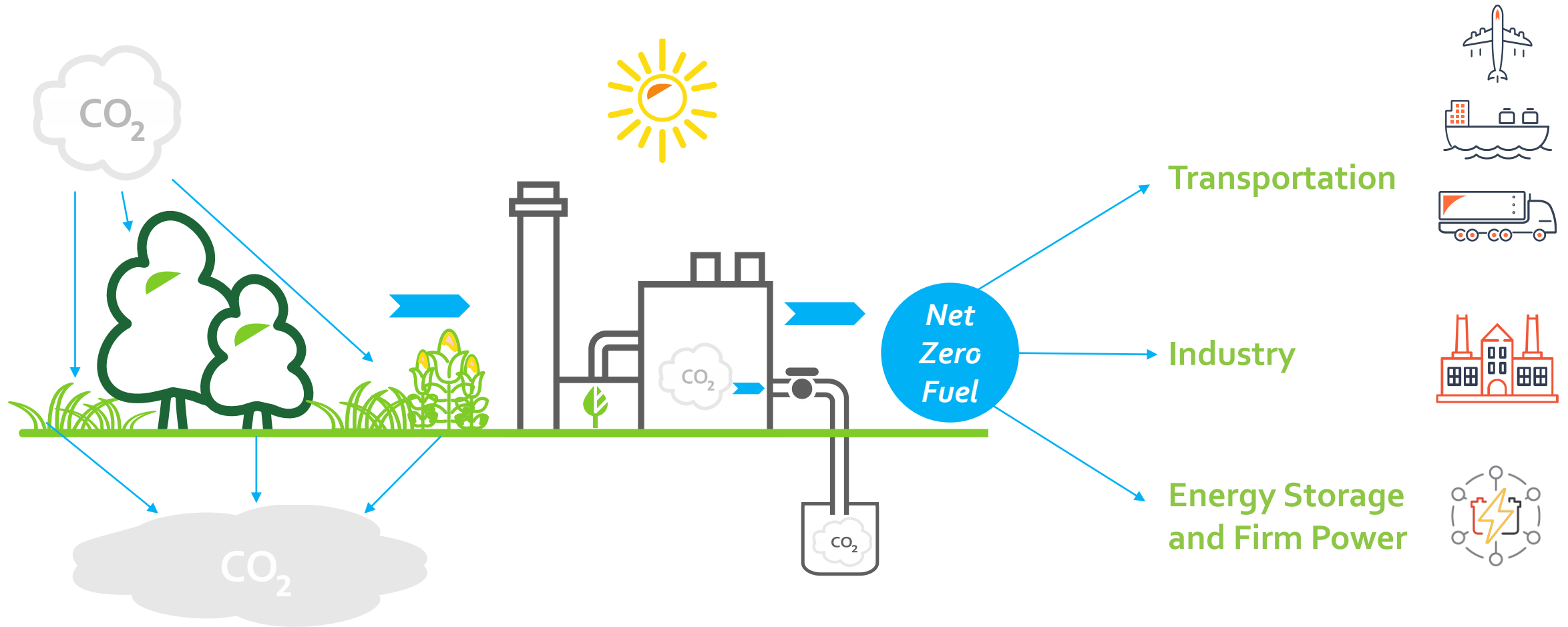


Drop-in Liquid Fuels

- Renewable diesel & gasoline, sustainable aviation fuel (SAF), EtOH
- Replace petroleum gasoline, diesel, or jet fuel
- Decarbonize non-electrified LD, HD, and non-road vehicles

Bioenergy with carbon capture & sequestration (BECCS)

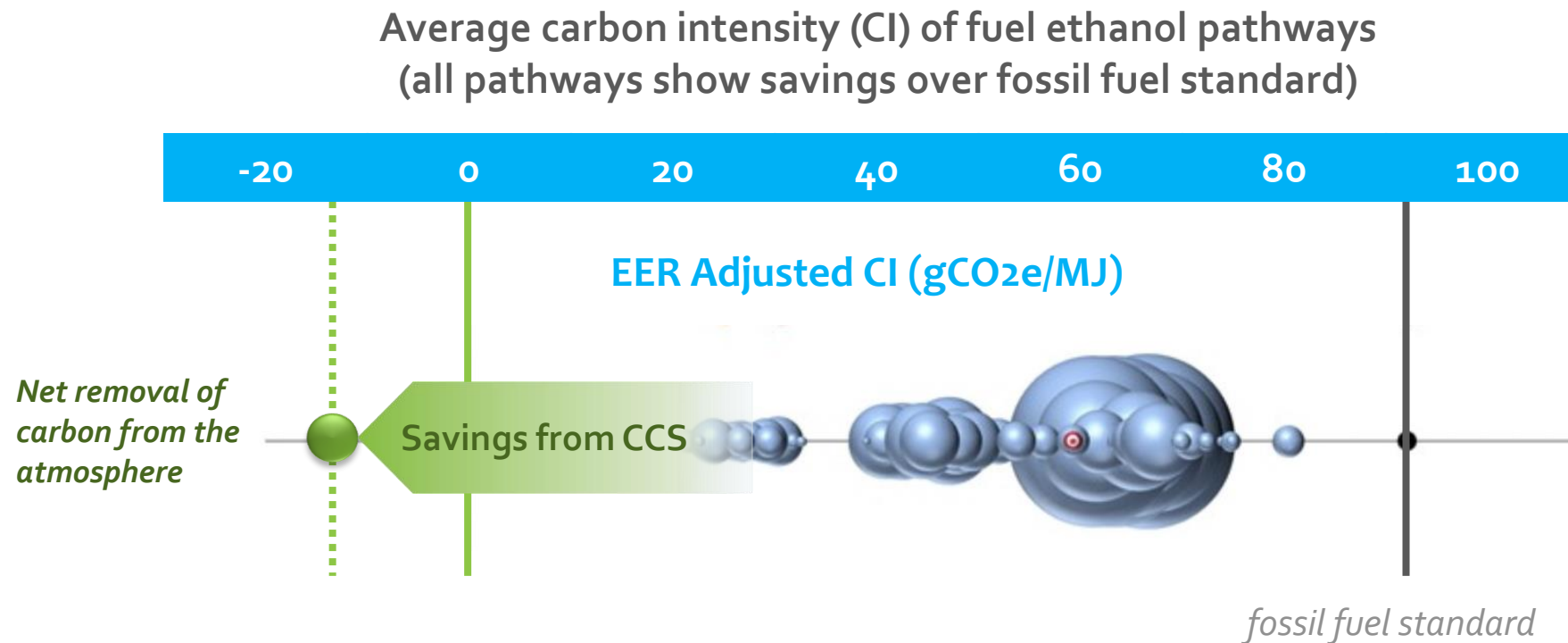
Removing atmospheric carbon while creating energy supplies



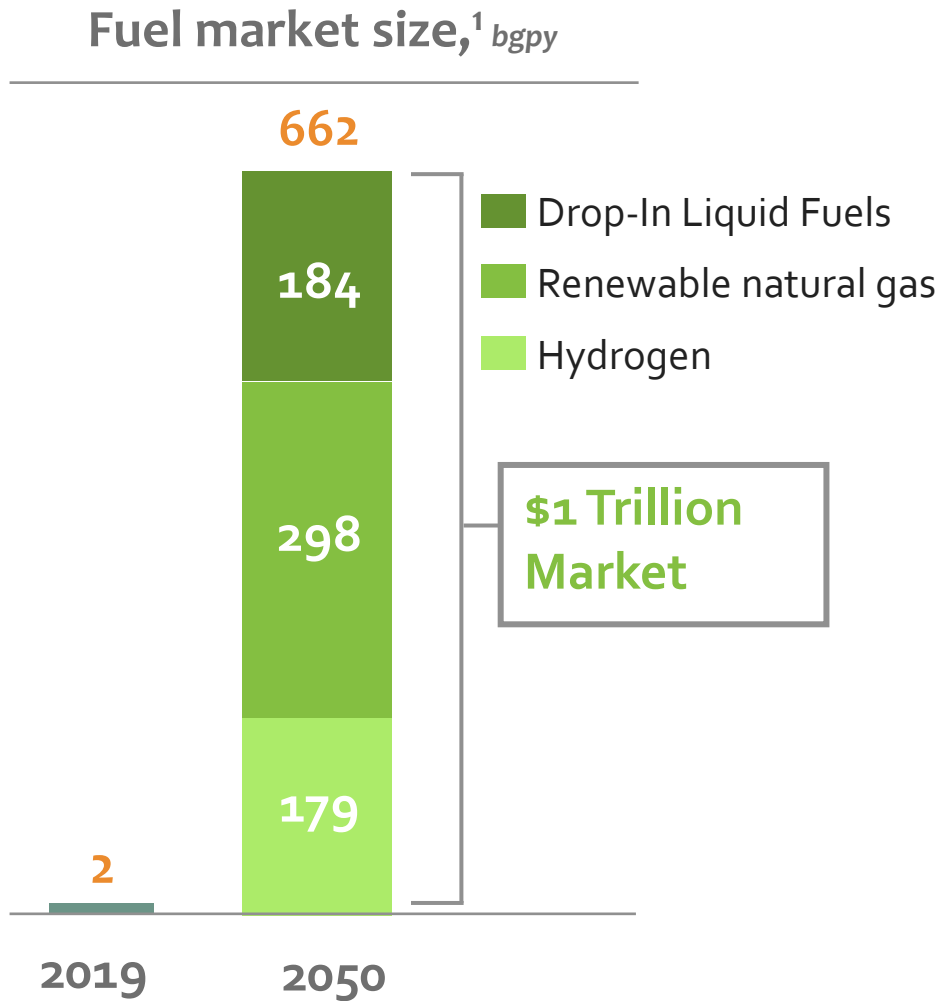
Evolution of Ethanol

“Conventional” corn ethanol has shown substantial reductions in carbon emissions – driven by a shift to renewable energy supply.

Adding carbon capture & storage will make corn ethanol a carbon negative fuel.



Investment signals are necessary



¹ Based on IEA 2040 "Sustainable Future" scenario prorated for 2050 net-zero, excludes solid biomass and food/feed-based biofuels



Fuels decarbonization, including hydrogen and liquids fuels, will require the deployment of technologies that are not yet commercial or not currently deployed at a significant scale.

Environmental Defence Fund, Marginal Abatement Cost Curves for U.S. Net-Zero Energy Systems

Maximize use of EPA's existing authorities to accelerate GHG emission reductions and increase technology neutrality

We support technology-neutral decarbonization approaches

- California's LCFS has driven **investment and innovation**
- Congress should authorize a carbon performance approach
- EPA has the resources and experience to provide crucial information to support legislative efforts in Congress

1

Cellulosic RVO

- Allow carryover of cellulosic annual RIN surpluses or shortfalls to reduce market volatility

2

Set Rule: Use Ambitious Targets for the Least Carbon Intensive Fuels

- Set cellulosic target using historic rate of growth
- Use the RIN carryover approach to eliminate market, regulatory, political, and litigation risks of projecting cellulosic production in future years

3

Ensure technology-neutral vehicle standards

- Mandate open fuel standard for light duty hybrid vehicles
- Allow/anticipate biofuel-powered HD engines where electrification is slow/not possible

4

Expand available RFS pathways to support new fuel development

- Approve H₂ pathway applications to build commercial momentum low carbon H₂
- Broad use of pathway authority to expand fuel options

Thank you!



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