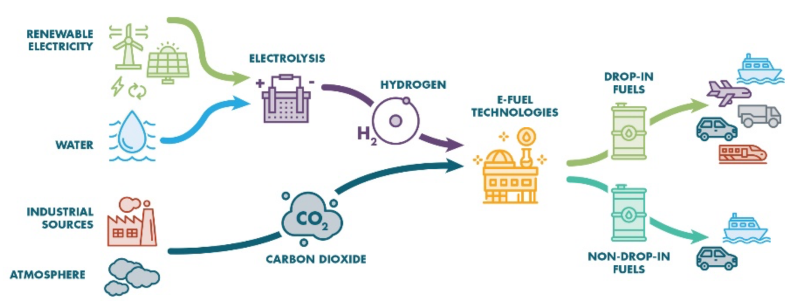
Why did TEI choose to study e-fuels?
The United States road transport sector accounts for 22% of US greenhouse gas (GHG) emissions and global leaders have determined that reducing carbon emissions from transportation is a high priority. With 1.5 billion internal combustion engine vehicles in the world and tens of millions more sold each year, we must find a way to reduce emissions from these vehicles to achieve environmental objectives. The only way to do this is to reduce the carbon intensity of the liquid fuels on which they operate, and e-fuels represent a viable option worth exploring.

High Level Summary of Findings

What are e-fuels? (Page 13) E-fuels are renewable fuels produced from water, renewable electricity and carbon dioxide (CO_2) via chemical or biochemical processes, which can be used to decarbonize the road, aviation, maritime, and rail sectors. The CO_2 can be captured from point source emissions via carbon capture and sequestration (CCS) technologies or directly from the air using direct air capture (DAC) technologies.

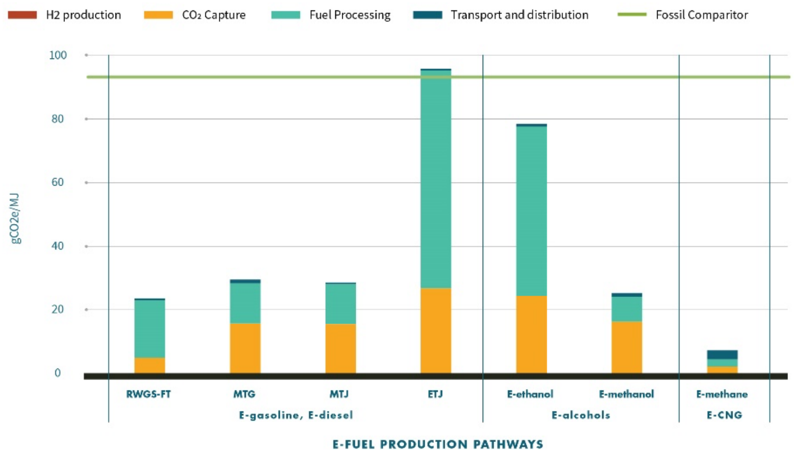
FIGURE 1-1. E-FUEL PRODUCTION PROCESS



How can e-fuels be used? *(Page 22)* E-fuels produced for on road transportation vehicles are considered drop-in fuels, which means they can be used just as the market currently uses gasoline, diesel and biofuels, without modification of vehicles or equipment. E-fuels can be used independently or as a blend of any concentration, enabling them to extend the fuel supply and reduce the carbon intensity of the fuel used in vehicles, thereby reducing emissions.

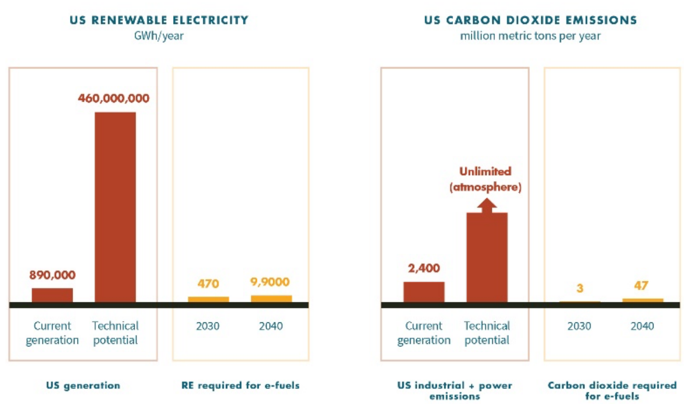
How can e-fuels support GHG emissions reductions? *(Page 39)* E-fuels could close potential emission reduction gaps or accelerate emission reduction efforts in road transportation. By leveraging renewable electricity and recycling CO_2, some e-fuel production pathways could produce drop in fuels for on-road vehicles with a 75% reduction in life cycle greenhouse gas emissions compared with fossil gasoline.

FIGURE 3-3. WELL-TO-WHEEL GHG EMISSIONS FOR E-FUEL PATHWAYS FOR NEAR-FUTURE PRODUCTION CONFIGURATIONS.



Are there sufficient resources to support e-fuels production? *(Page 71)* In the U.S., the electricity required to produce e-fuels would represent less than 1% of renewable electricity generation in 2024. In addition, e-fuels would consume less than 1.6% of all CO_2 emissions from the industrial and power sectors. Implementing carbon capture systems and CO_2 distribution infrastructure will be critical elements to support e-fuels production.

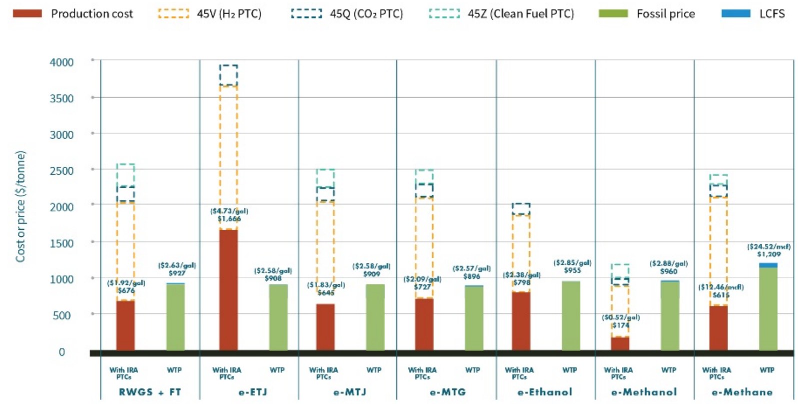
FIGURE 4-8. U.S. RENEWABLE ELECTRICITY GENERATION AND CARBON DIOXIDE EMISSIONS AND REQUIREMENTS



Bars are not to scale

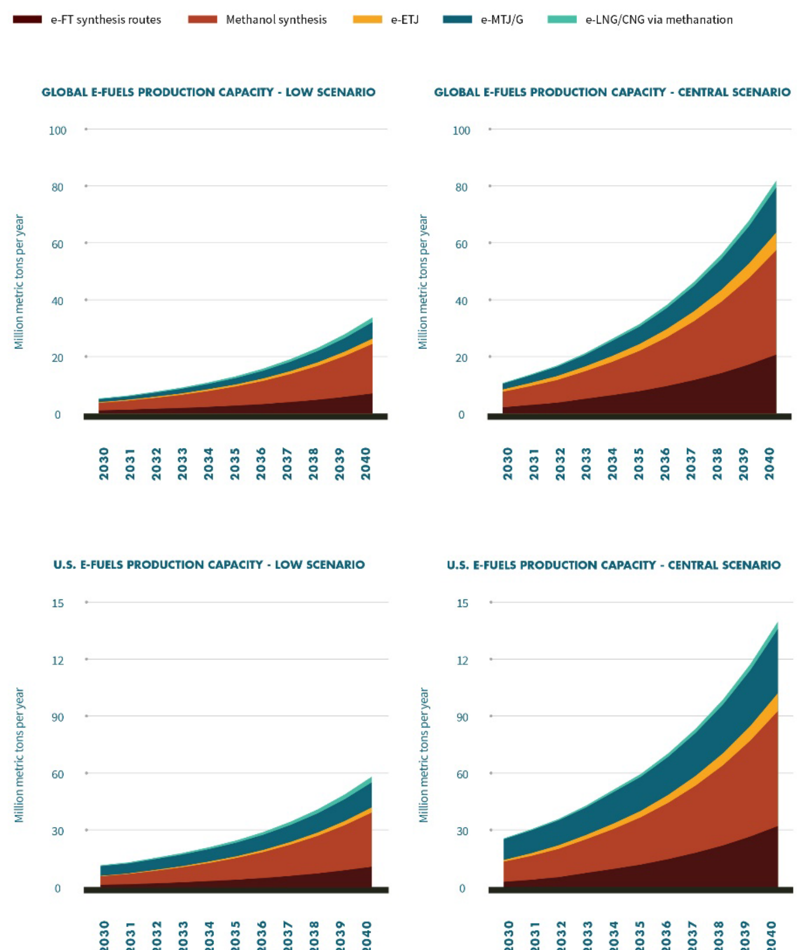
Will e-fuels be affordable? *(Page 79)* Currently, e-fuel production is approximately 2.5 – 4 times more expensive than comparable fossil fuels. However, when considering the impact of current U.S. policies and global production expectations over the next 15 years, production of many e-fuel products in future plants (NOAK = "Nth Of A Kind" plant) could yield products that are priced lower than the consumers' expected willingness to pay (WTP).

FIGURE 6-6. PRODUCTION COSTS AND POLICY SUPPORT FOR FUTURE NOAK PLANTS
(ALL FUEL PATHWAYS)



How much e-fuel can be produced? *(Page 60)* By 2040, given the expected increase in commercial production facilities, e-fuel production in the U.S. could increase to 4.7 billion gallons (14 Mt) pe year and globally to 27.5 billion gallons (82 Mt) per year.

FIGURE 4-4. E-FUELS PRODUCTION CAPACITY GLOBALLY AND IN THE U.S.



What policies affect the viability of e-fuels? *(Page 98)* Low carbon fuel policies can be characterized as a technology-push (e.g. production subsidies) or market-pull (e.g. clean fuel standards) policy. Technology-push policies help drive early-stage development towards commercialization and encourage scale-up of production within the region. Market-pull policies ensure demand and a willingness to pay (WTP) for the resulting product to be used within the region. In the U.S., there is a mixture of pull (e.g., RFS2, LCFS) and push (e.g., 45Z Clean Fuel PTC, 45V Clean Hydrogen PTC, 45Q Carbon Sequestration TC) policy instruments that are relevant to low carbon fuels, including e-fuels.