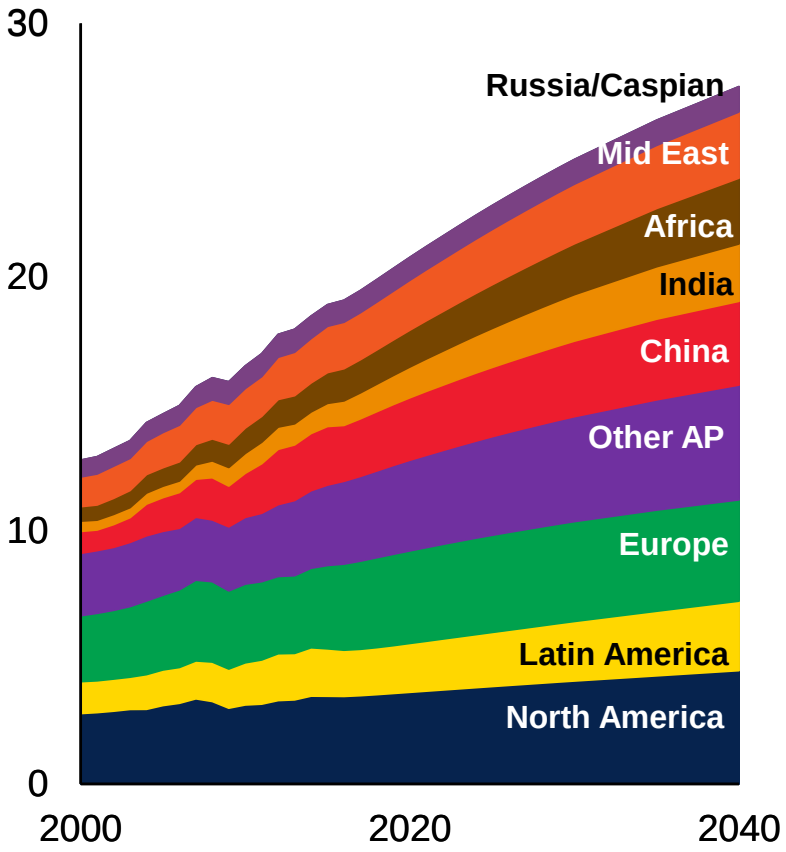
Heavy Duty Transportation

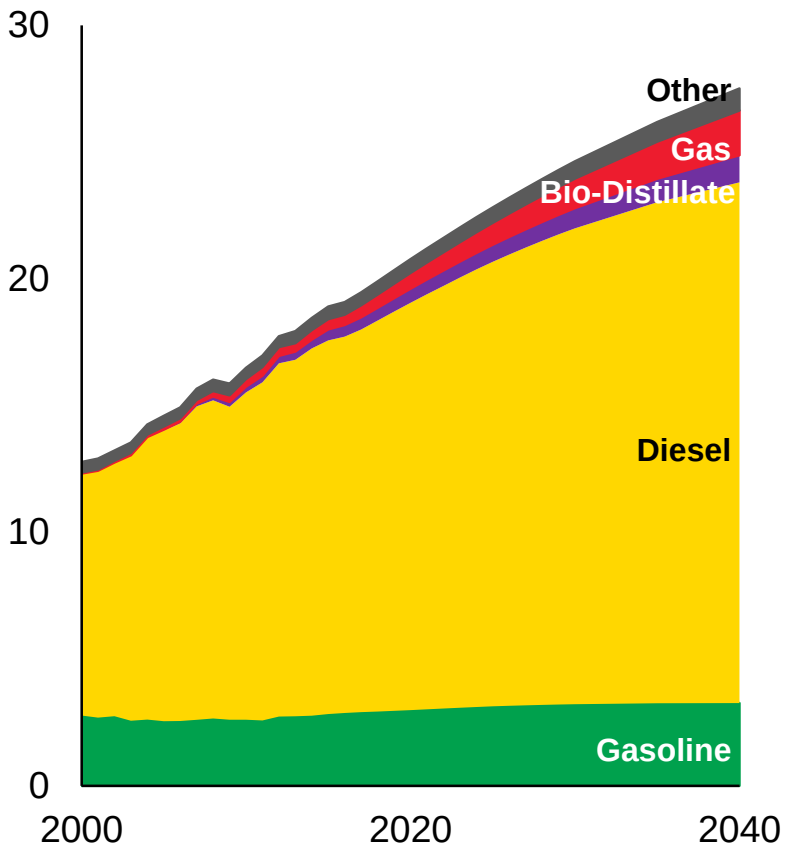
By Region

MBDOE



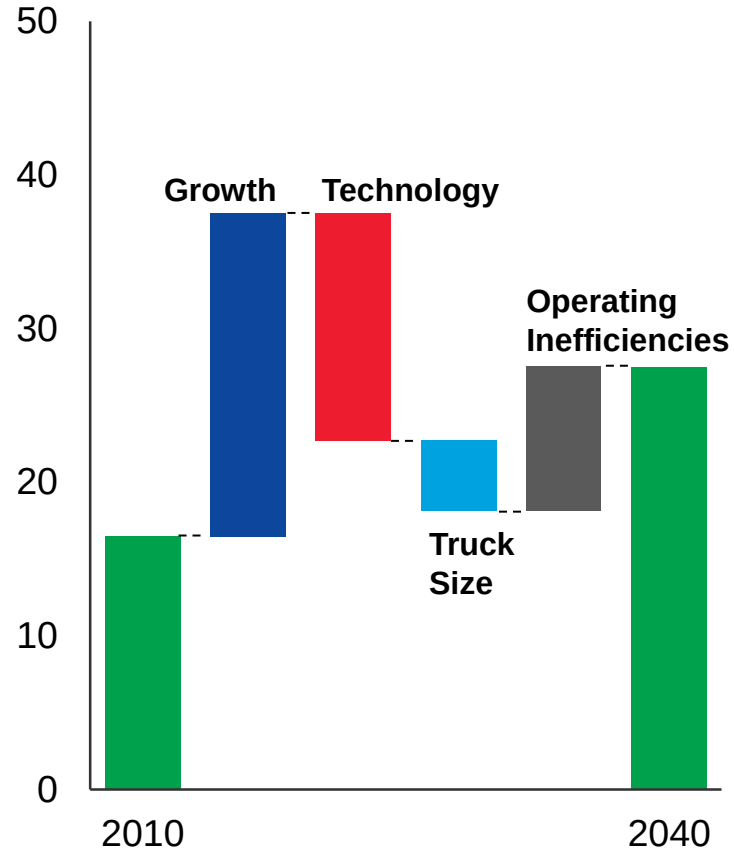
By Fuel

MBDOE



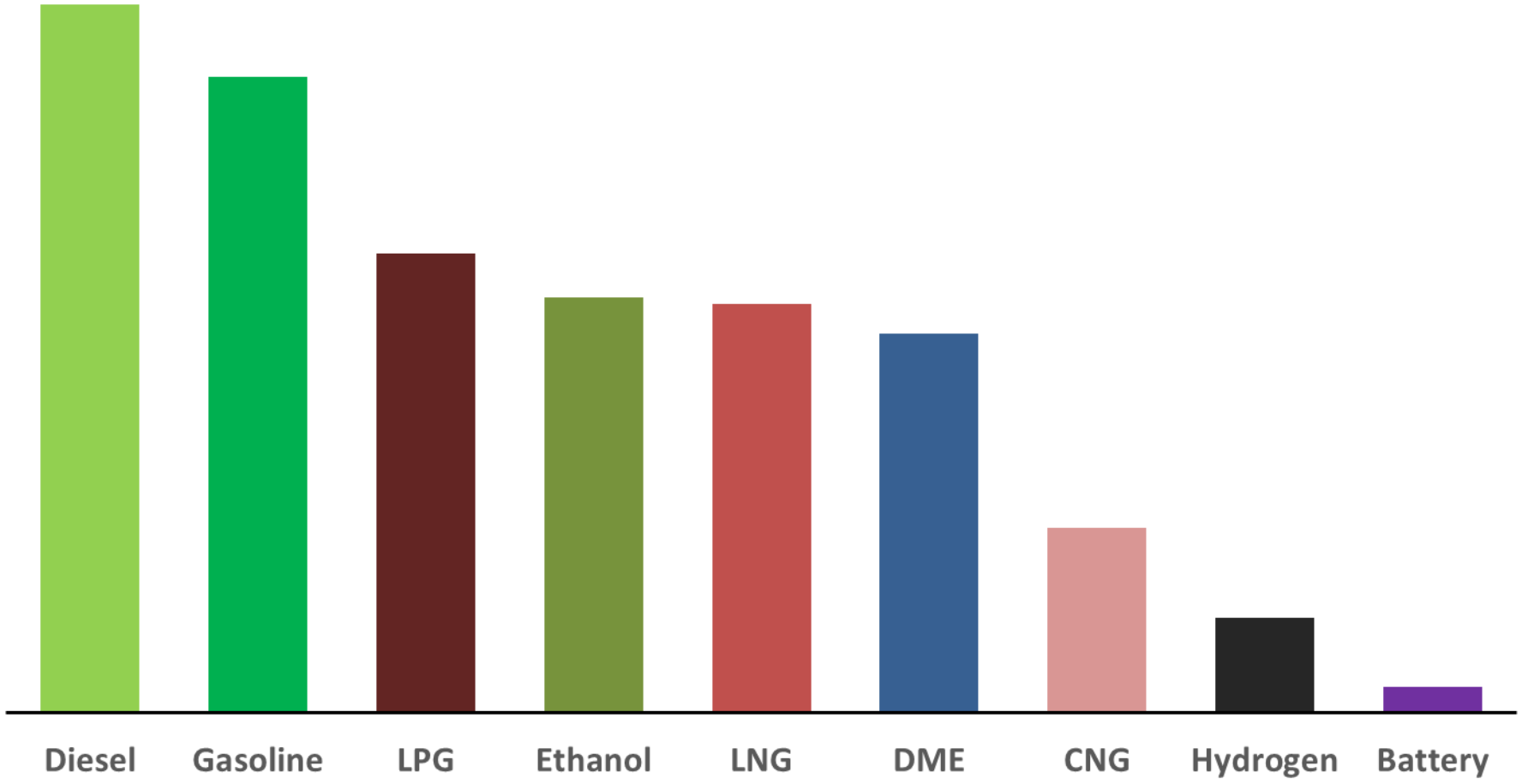
Efficiency Impact on Fuel Demand

MBDOE



Relative Energy Density

Volumetric Energy
Relative to Diesel



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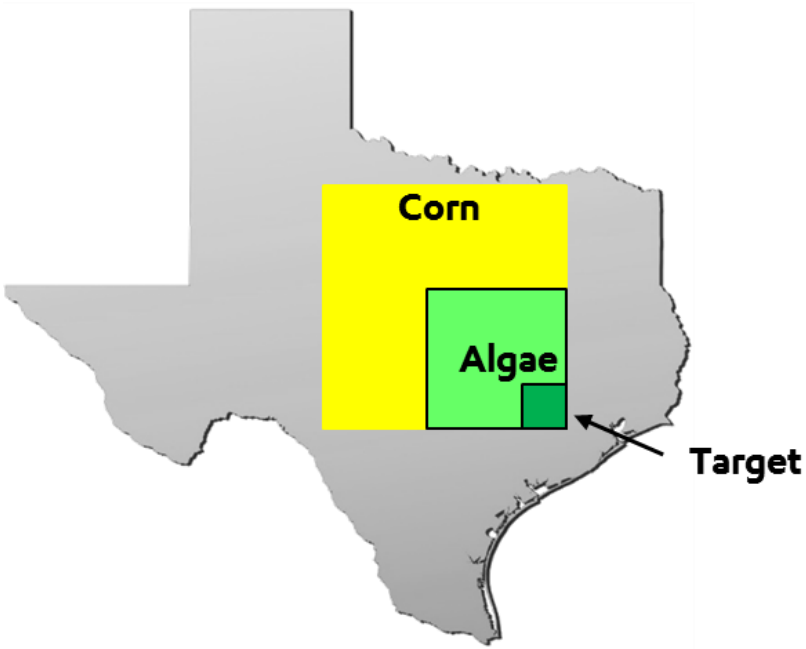
Alternative Fuels for Heavy Duty Trucks

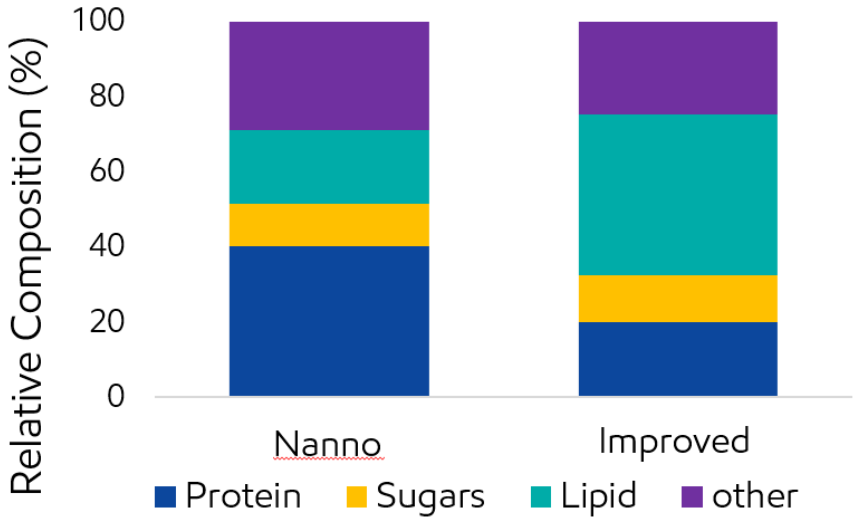
- **Bio-distillates (FAME, renewable diesel) are commercially available at scale**
  - + May offer significant GHG reduction potential if from algae or cellulosic sources
  - + Blendable/drop-in
- **CNG attractive for centrally fueled fleets and short-haul trucks**
  - + Simpler after-treatment if SI
  - + Lower GHG if from bio-methane but limited scale
  - ▫ Economics depends on the relative costs of the vehicle and fuel (varies by region)
- **Potential for LNG use in long-haul heavy duty trucking**
  - − Boil-off, fugitive emissions need to be managed
  - − Higher vehicle cost
- **Hydrogen offers lower GHG if sourced from fossil with CCS or non-fossil; significant infrastructure challenge**
- **DME has lower PM emissions; efficient synthesis from natural gas; can be sourced from bio materials**
- **Ethanol heavy duty truck engines are available; ethanol available commercially at scale;**
  - + Offers significant GHG reduction potential if production combined with CCS or if from cellulosic sources

Algae Biofuels

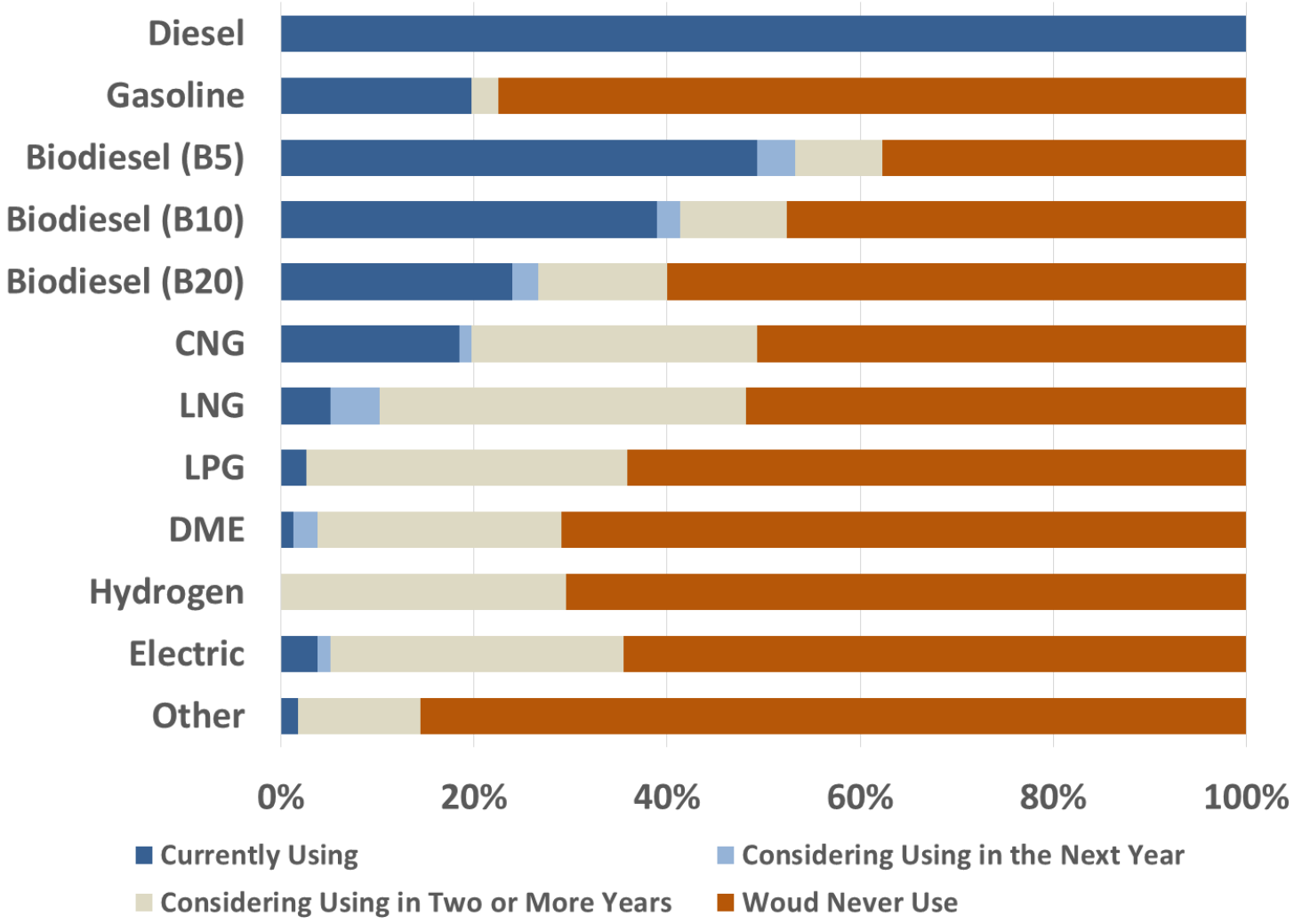
- very high biomass productivity
- year-round growth
- land and water unsuitable for crops



Area required to replace 10% of U.S. road transportation demand



North American Fleet Owner Survey



Source: Schoettle, Sivak, Tunnell, “A Survey of Fuel Economy and Fuel Usage by Heavy Duty Truck Fleets”, SWT-2016-12, University of Michigan Sustainable World Transportation

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Closing

- **Most of the heavy duty fuel demand is likely to remain diesel**
- **Of the lower GHG potential fuels –**
  - Bio-distillates from algae and cellulosic sources; further technology development needed; fuel cost
  - Hydrogen if sourced from fossil with CCS or non-fossil; significant infrastructure challenge; fuel and vehicle cost
  - Ethanol with CCS could have cost and scale advantages; further potential with cellulosic ethanol; bespoke engines
  - Bio-methane and derivatives; insufficient scale/availability; fuel cost
- **Fleet owners have a strong incentive to reduce fuel costs**
  - Fuel economy (driven by fuel cost reduction imperative) may be the most important factor in GHG emissions reduction from this sector
  - Alternative fuels (and vehicles) need to compete on cost; payback period
  - Fuel choices need to be acceptable to fleet owners

Operating Costs for North American Fleet Operator

Source: NREL (2013)


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