

DOE Bioenergy Summit



A Sempra Energy utility®

The Promise of Renewable Gaseous Fuels

June 24, 2015

Jeff Reed, Southern California Gas Company

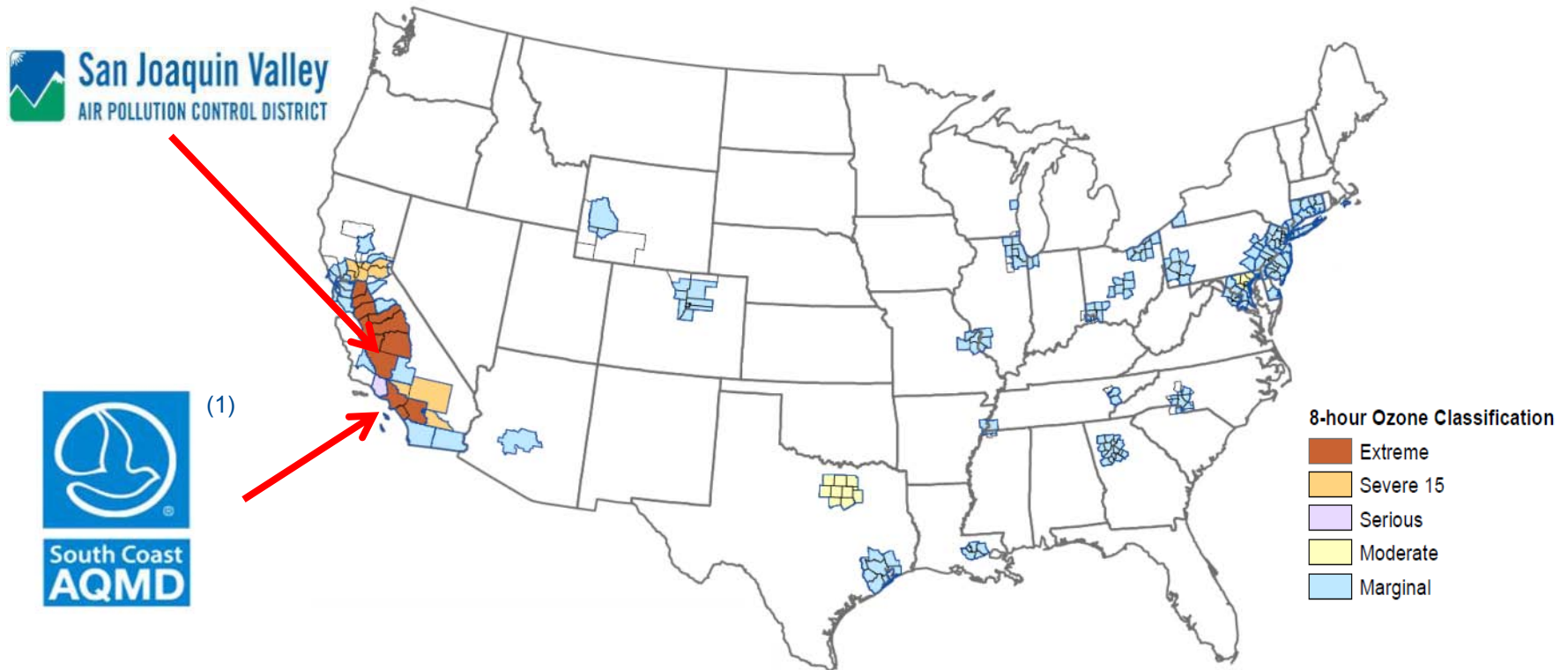
Southern California Gas Company

- » **The nation's largest natural gas distribution utility**
 - **20.9 million consumers**
 - **5.8 million meters**
 - **500 communities**
- » **Subsidiary of Sempra Energy (SRE)**
- » **Affiliated with SDG&E**
- » **Leader in customer satisfaction, pipeline safety and environmental solutions**



NOx is a Unique Challenge for SoCal

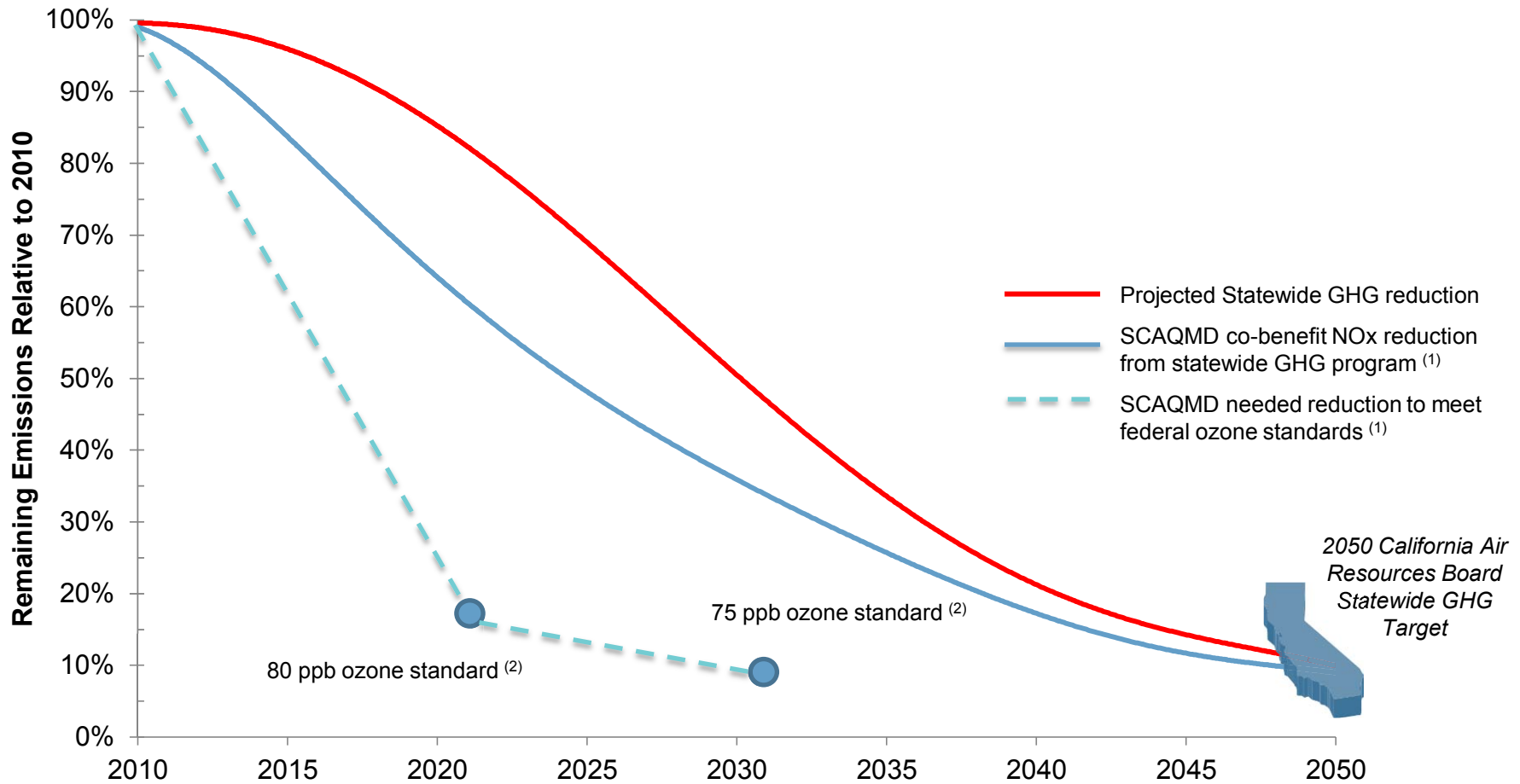
Over **80%** of Southern California is in “Extreme” non-attainment areas for meeting federal ozone standards:



Source: [US EPA Green Book, 8-Hour Ozone Nonattainment Areas \(2008 Standard\), published 7/31/2013.](#)

¹ Air Quality Management District (AQMD)

Need 80%+ Reductions in Both NOx and GHG



¹ South Coast Air Quality Management District (SCAQMD)
² parts per billion (ppb)

Methane as a transportation fuel can address 2050 goals through total vehicle system improvements and RNG fuel blends



Methane pathways are complementary to hydrogen pathways and may serve different vocations

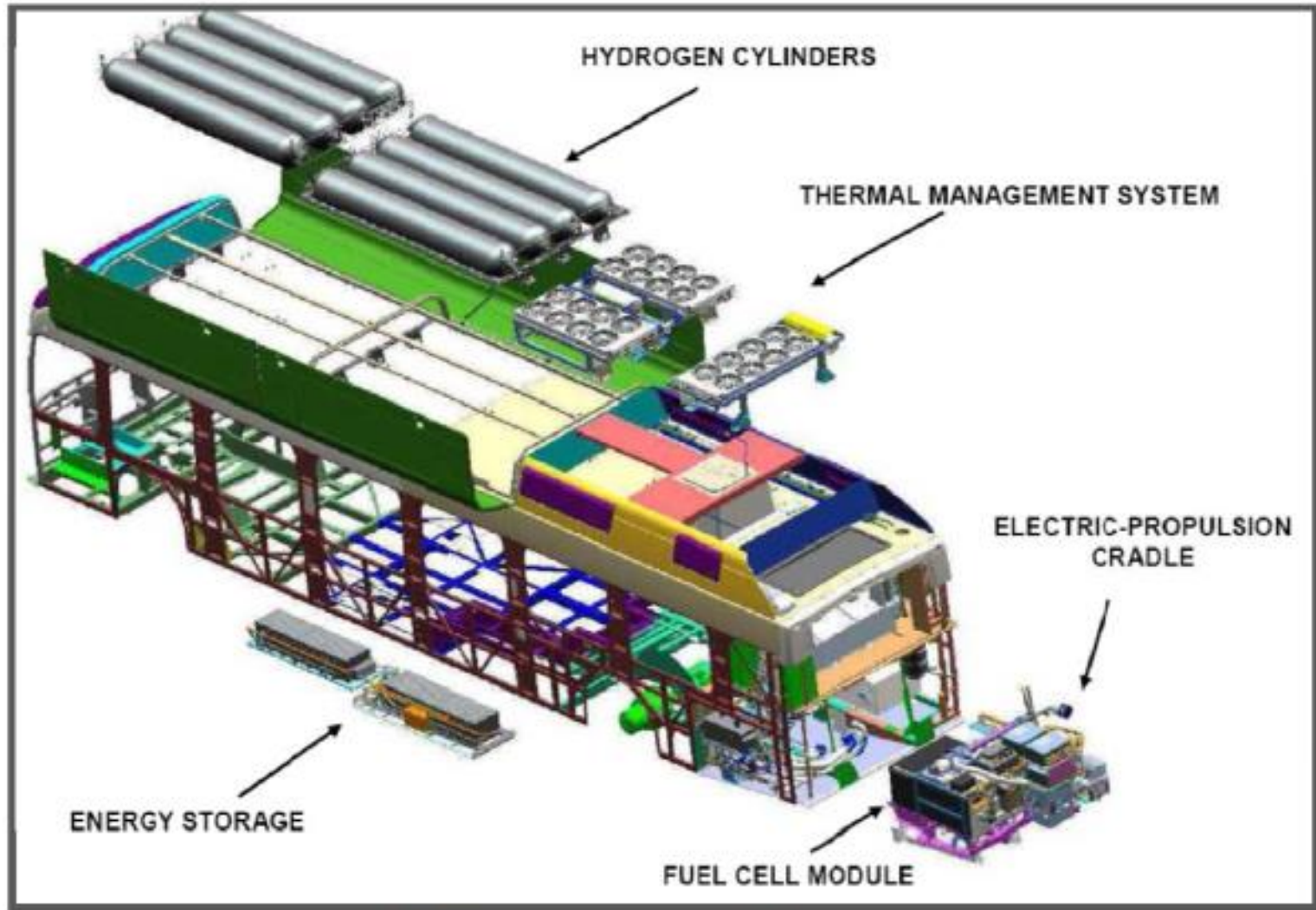
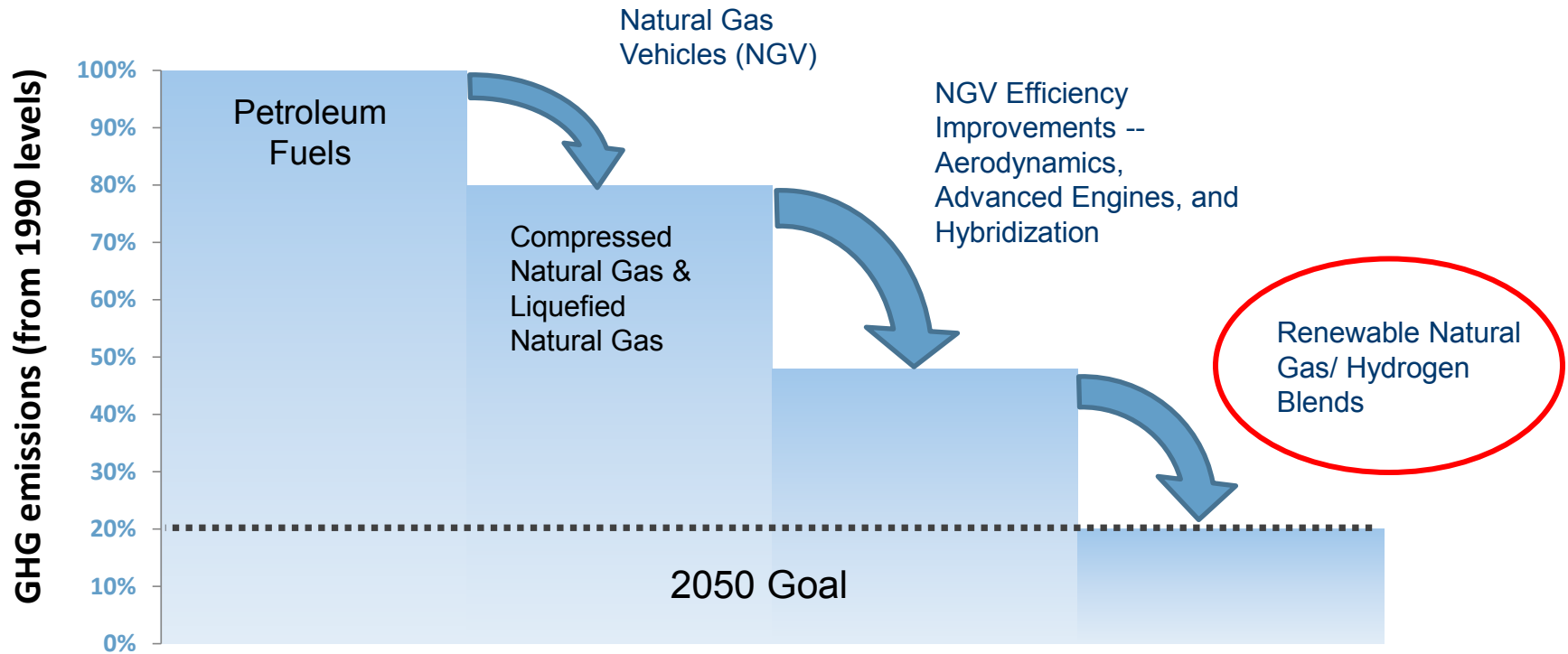


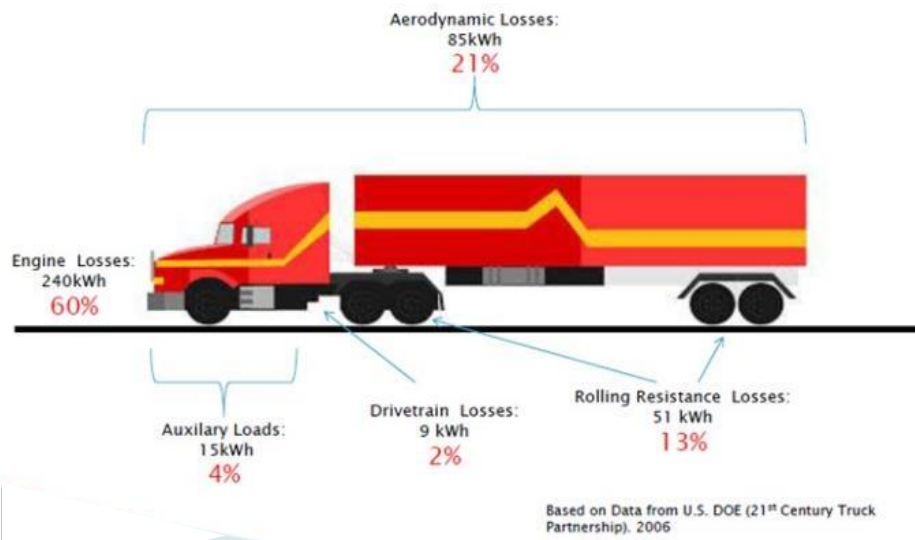
Figure A. FCEB components – Source: Ballard Power Systems

Renewable Natural Gas is a necessary part of the path to 2050



Fuel economy improvement will be critical for all vehicle platforms -- Natural Gas platforms have similar fuel economy potential to diesel platforms

Breakdown of Energy Loss for Long Haul



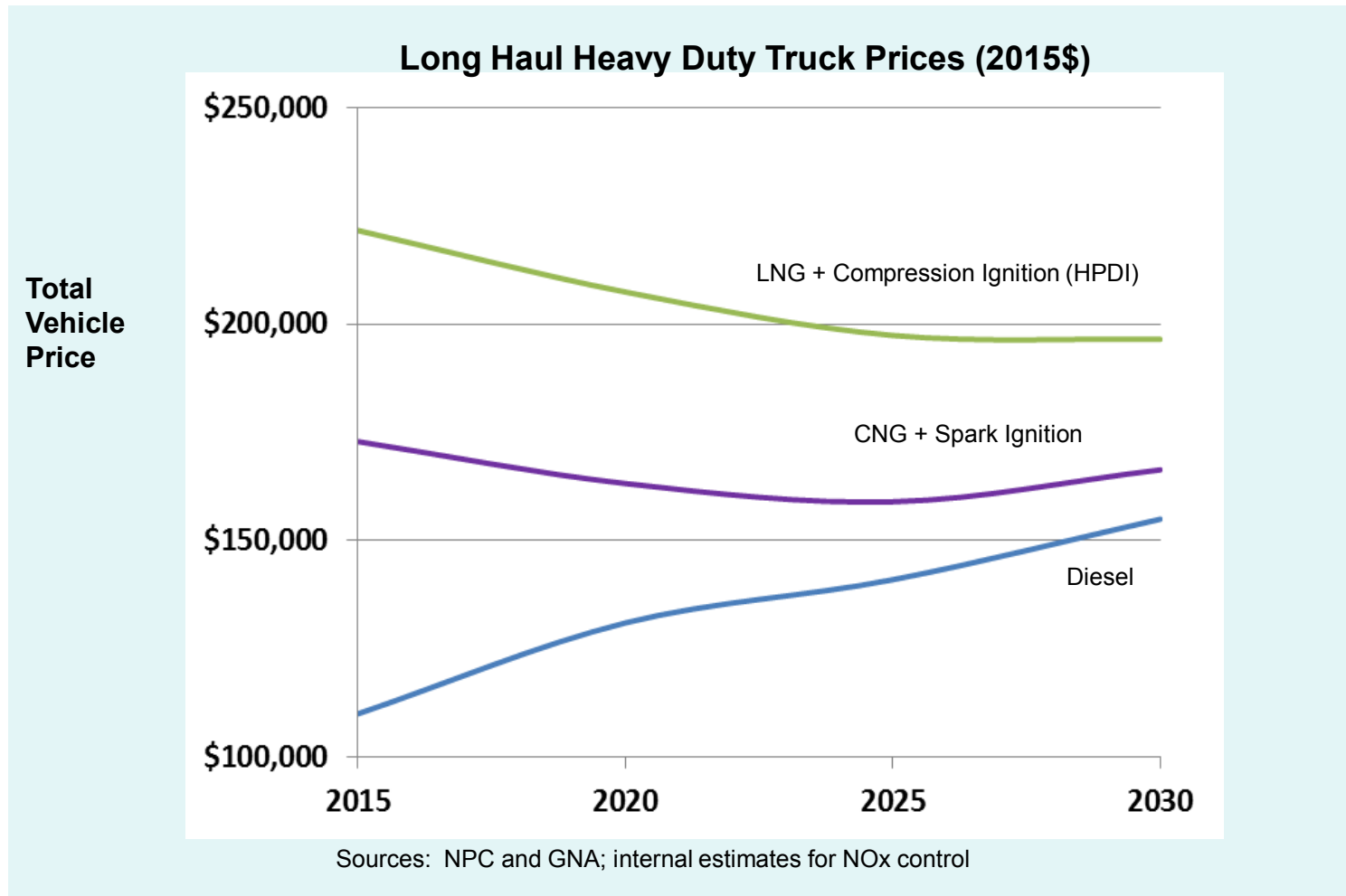
Source: Department of Energy "Super Truck" program

Sources of Fuel Economy Improvement

Fuel Economy Contributor	Highway	Urban Vocation
Engine	15% - 20%	15% - 20%
Hybridization	10%	30% - 35%
Aerodynamics	12%	0% - 6%
Transmission	7%	4%
Rolling Resistance	11%	2% - 3%
Weight	1%	1% - 4%

Source: National Petroleum Council

Vehicle economics and fuel price have the potential to meet emissions goals without the need for long-term subsidies



Renewable and zero-carbon pathways are key

Natural Gas w/ CCUS

Organics Conversion

Power-to-Gas

Artificial Photosynthesis



Anaerobic Digestion

Thermo-chemical

Electrolysis



Renewable Natural Gas

Hydrogen

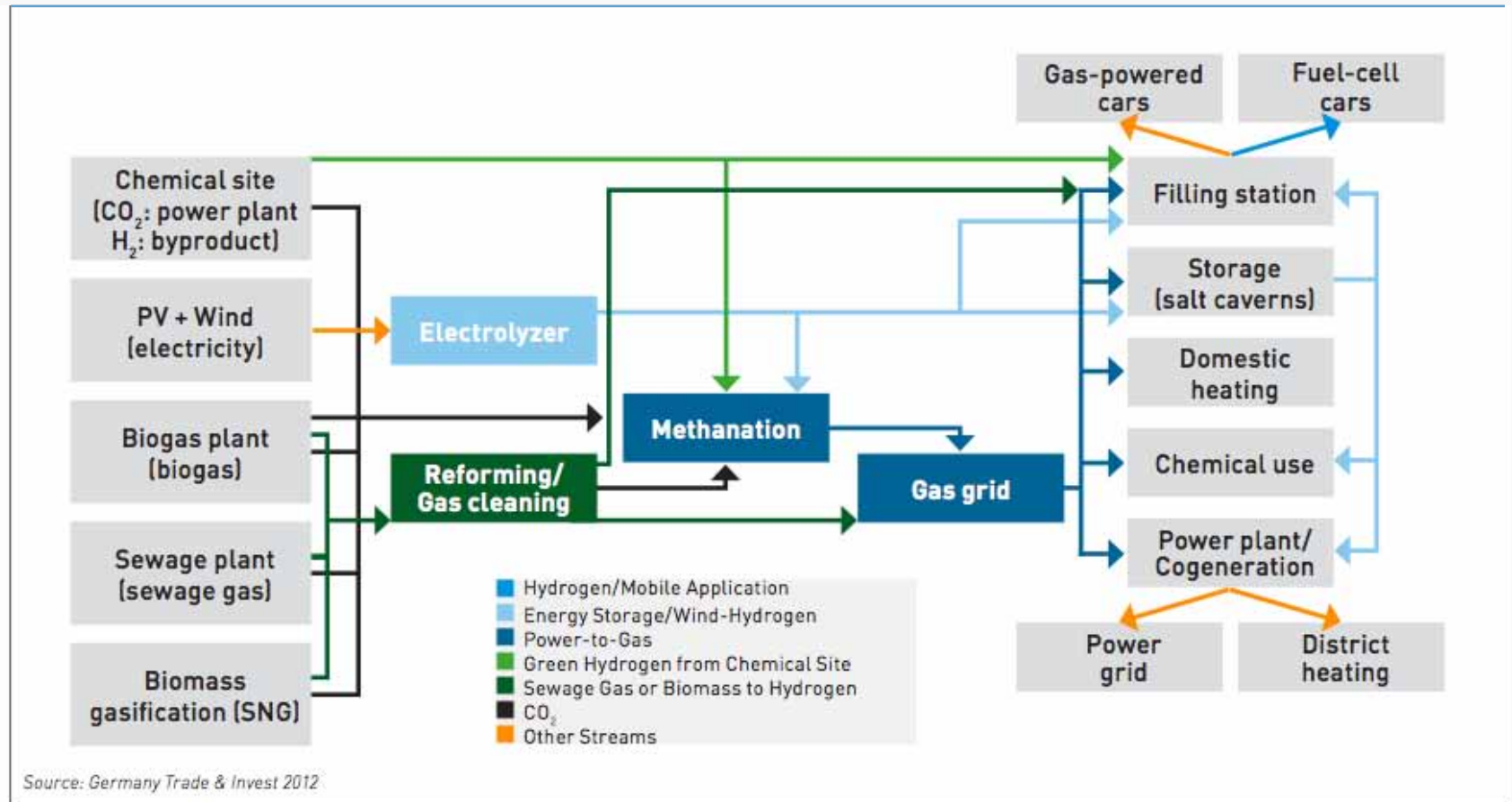
CO₂



Methanation

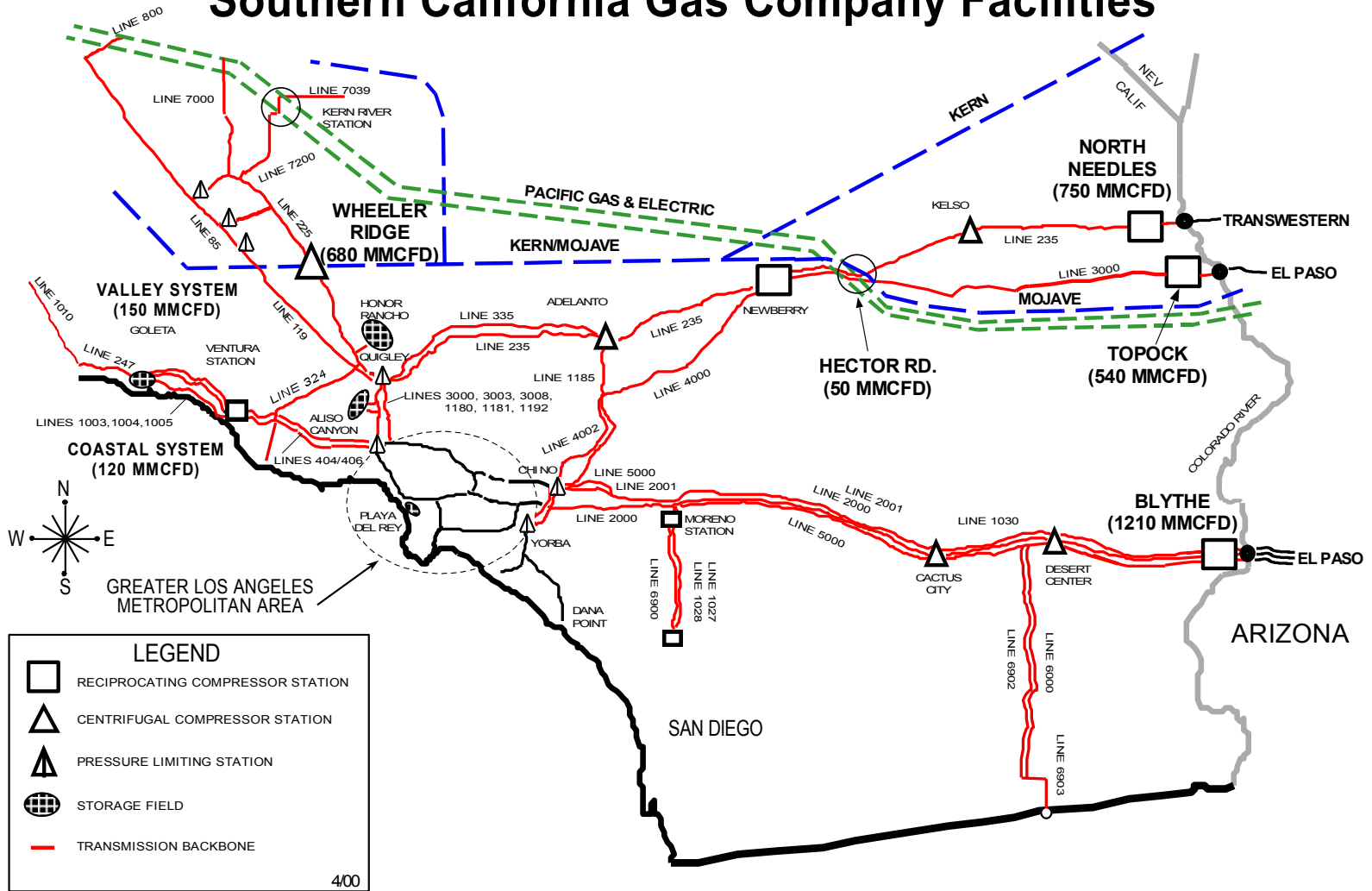
Reformation

Renewable Fuel Pathways and the Gas Grid



We Can Deliver Natural Gas Virtually Anywhere in SoCal

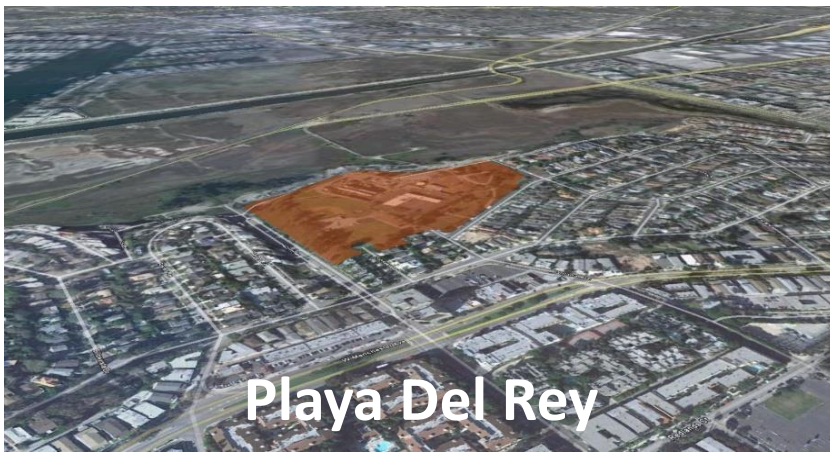
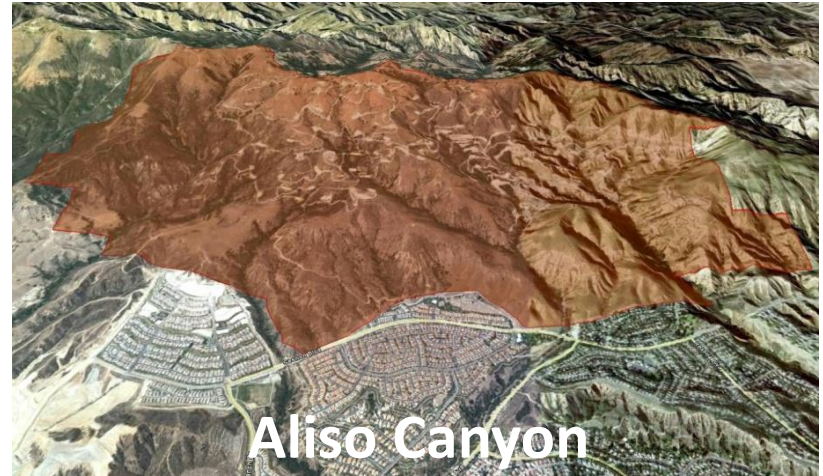
Southern California Gas Company Facilities



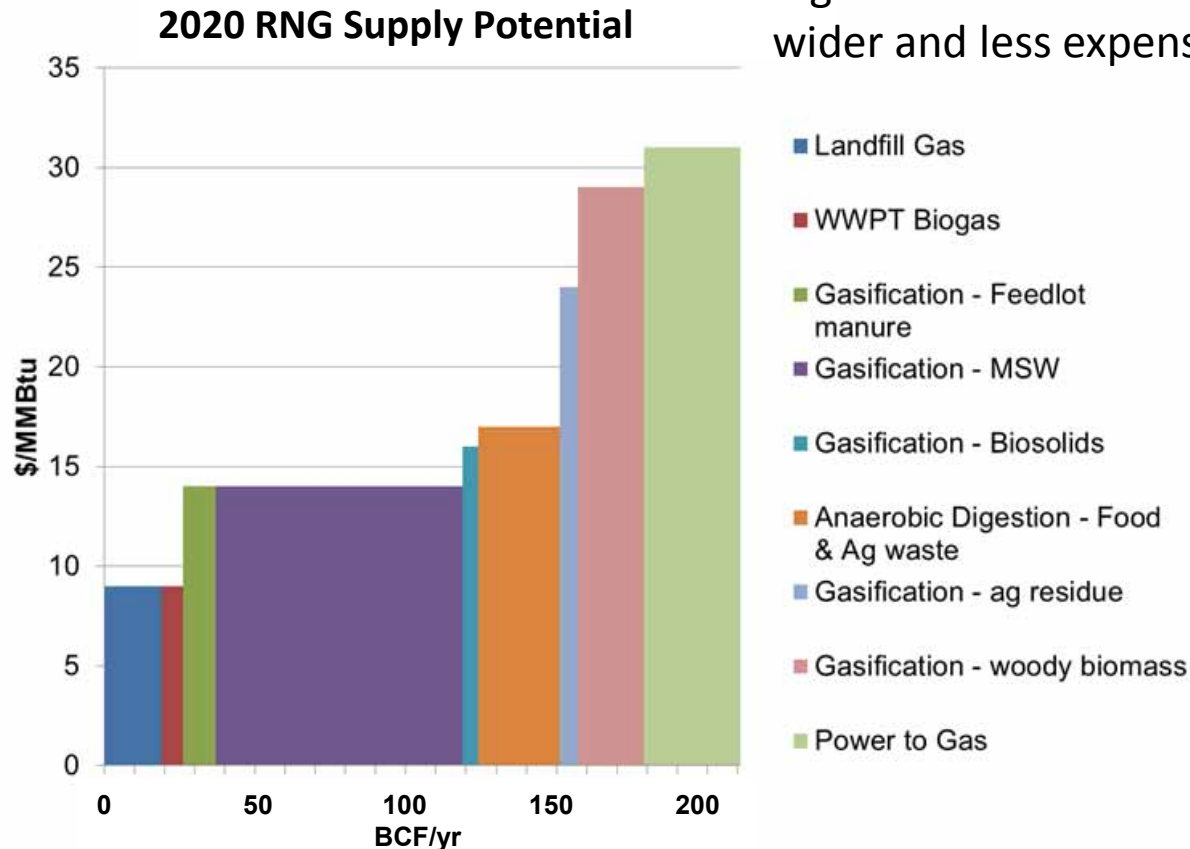
NOT TO SCALE

Vast Storage Infrastructure – Months of Capacity

Southern California Storage Resources

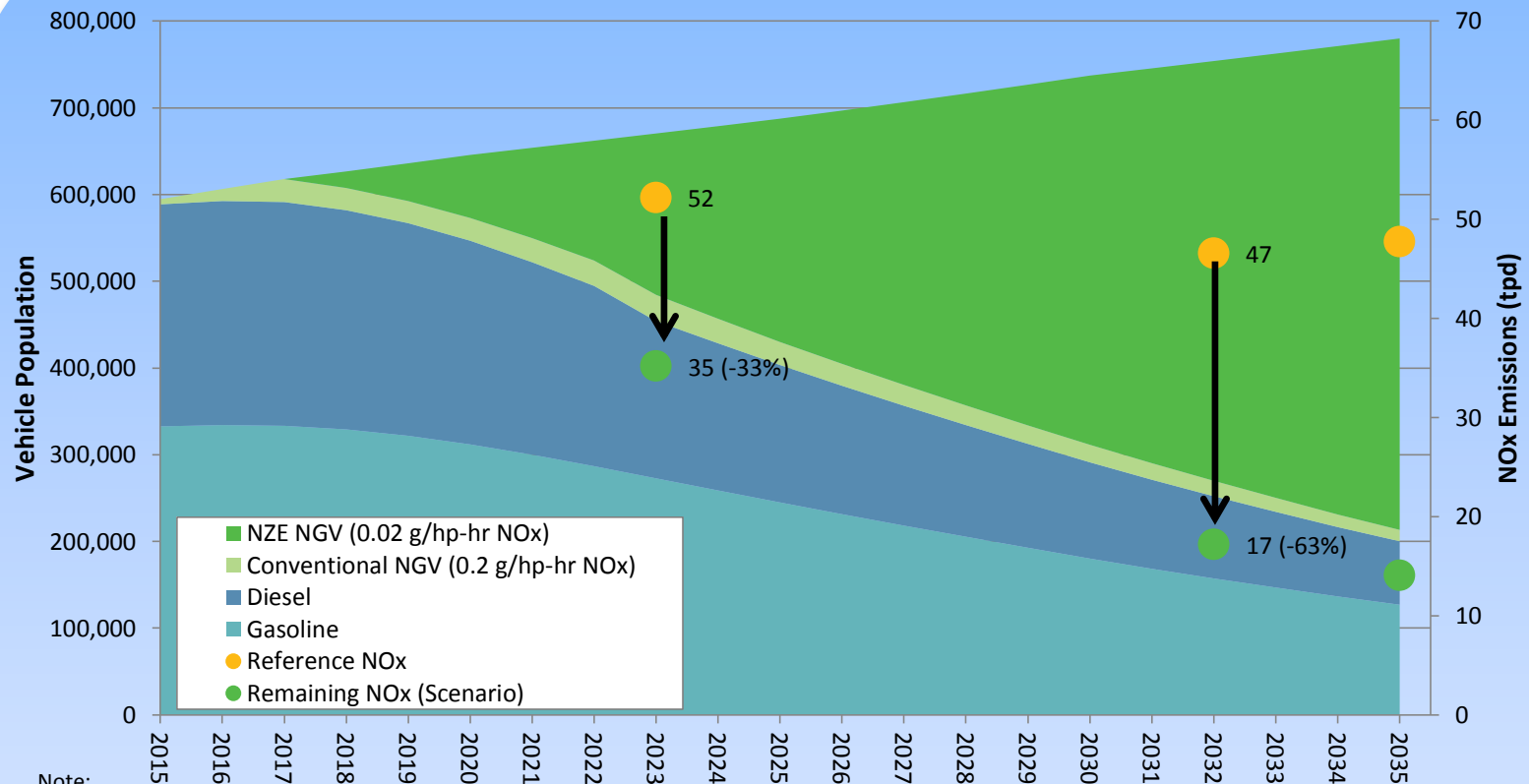


Bio-derived RNG is the low-cost pathway – energy crops offer further potential



In-state resources only, 50% resource conversion, no energy crops

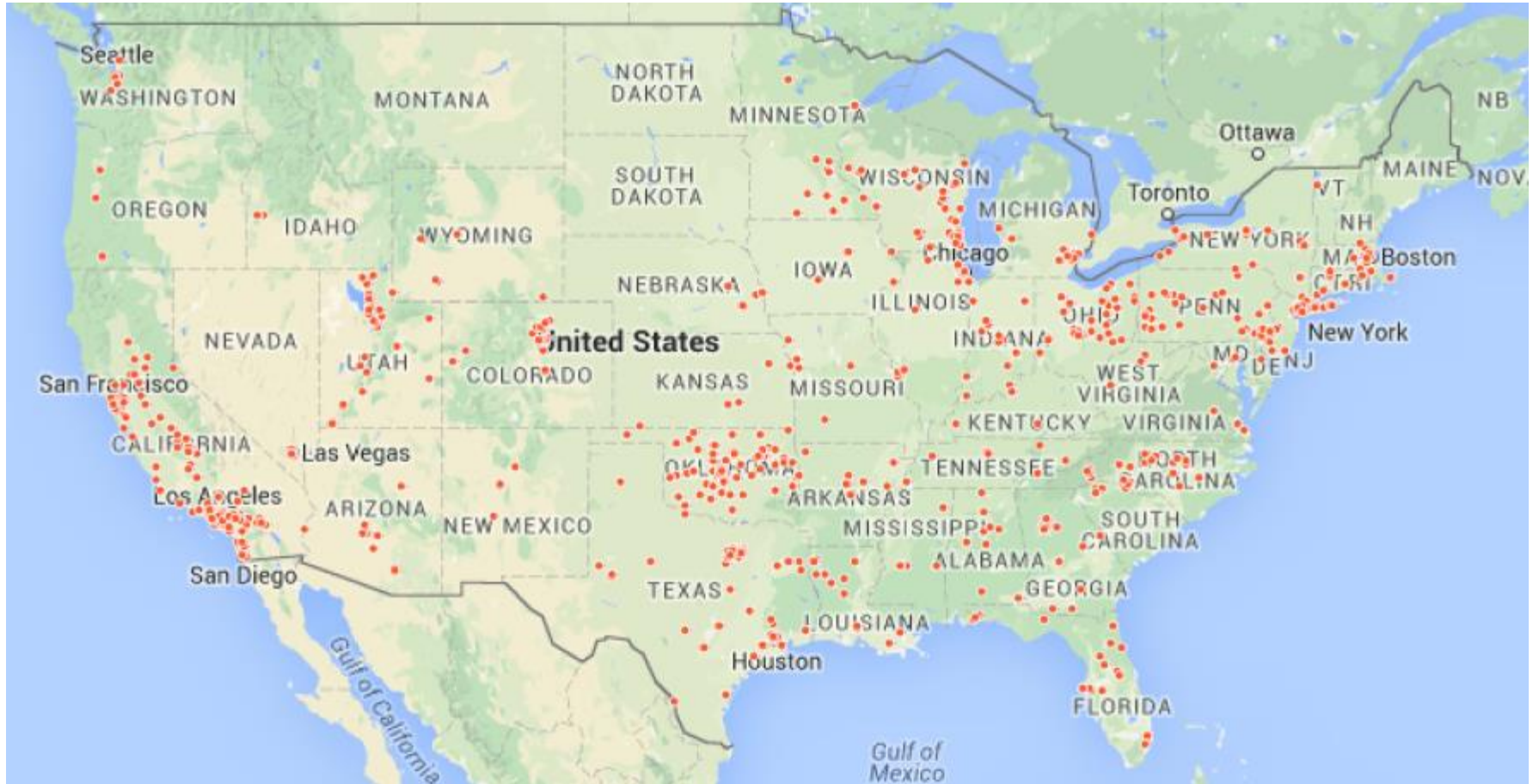
Major Nox co-benefit potential



Note:

1. Analysis includes T7 Drayage, T7 Single, T7 Solid Waste Collection Vehicle, T7 Tractor, T7 Tractor Construction, T7 Agriculture, T7 Single Construction, T7 Public, T7 IS, T6 Instate Heavy, T6 Instate Small, T6 Utility, T6 Public, T6 TS, T6 Agriculture, T6 Instate Construction Heavy, T6 Instate Construction Small, LHDDT, and LHD
2. Maximum incentives range from \$15,500 - \$35,000/Truck depending on the vehicle type and engine size
3. Assumed penetration rates after the incentive period ends remain at the 2023 level due to some mechanism
4. Incentive Program ends in 2023. post-2023 mechanism maintains new sales penetration of NZE NGV trucks at 2023 levels

RNG could be a drop-in fuel by 2025



Opportunity Areas

- » Use of dedicated energy crops to produce methane
- » Co-production of methane and hydrogen with other products
- » Joint deployment analysis and planning for all three primary renewable biofuels
 - Liquids
 - Methane
 - Hydrogen