



US Academy of Science on Alternative Fuels and Powertrains

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Presentation to



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National Academies of Science

- The National Academy of Sciences is a private, nonprofit society of distinguished scholars engaged in scientific and engineering research, dedicated to the furtherance of science and technology and to their use for the general welfare.
- Project of interest – “Reducing the Fuel Consumption and Greenhouse Gas Emissions of Medium- and Heavy-Duty Vehicles, Phase one and two”

History of truck fuel economy

- Phase one – published 2010
- It examined the science and engineering of fuel economy for present day regulatory action.
- Phase two – will be released in 2017 examine longer term regulatory initiatives through to 2030.

General approach

- Examination of the regulatory environment
- Market and background factors
- How technology change may impact regulations
- Certification and compliance and modeling
- Establishing baselines for future reference
- Suggested regulatory framework
- Powertrain technologies
- Technologies for reducing power demand

General approach cont.

- Projected benefits of technology on fuel consumption
- Hybrid electric powertrains
- Battery technologies
- Freight operational efficiency
- ITS and automation
- Manufacturing considerations
- Costs and benefits
- Alternative compliance and regulatory approaches

Key Issues

Greenhouse gas Emissions Model (GEM)

Identification

Manufacturer Name: Vehicle Configuration: Date:

Vehicle Family: Vehicle Model Year:

Regulatory Subcategory

- Class 8 Combination - Sleeper Cab - High Roof
- Class 8 Combination - Sleeper Cab - Mid Roof
- Class 8 Combination - Sleeper Cab - Low Roof
- Class 8 Combination - Day Cab - High Roof
- Class 8 Combination - Day Cab - Mid Roof
- Class 8 Combination - Day Cab - Low Roof
- Class 7 Combination - Day Cab - High Roof
- Class 7 Combination - Day Cab - Mid Roof
- Class 7 Combination - Day Cab - Low Roof
- Heavy Heavy-Duty - Vocational Truck (Class 8)
- Medium Heavy-Duty - Vocational Truck (Class 6-7)
- Light Heavy-Duty - Vocational Truck (Class 2b-5)

Simulation Inputs

Coefficient of Aerodynamic Drag:

Steer Tire Rolling Resistance [kg/metric ton]:

Drive Tire Rolling Resistance [kg/metric ton]:

Vehicle Speed Limiter [mph]:

Vehicle Weight Reduction [lbs]:

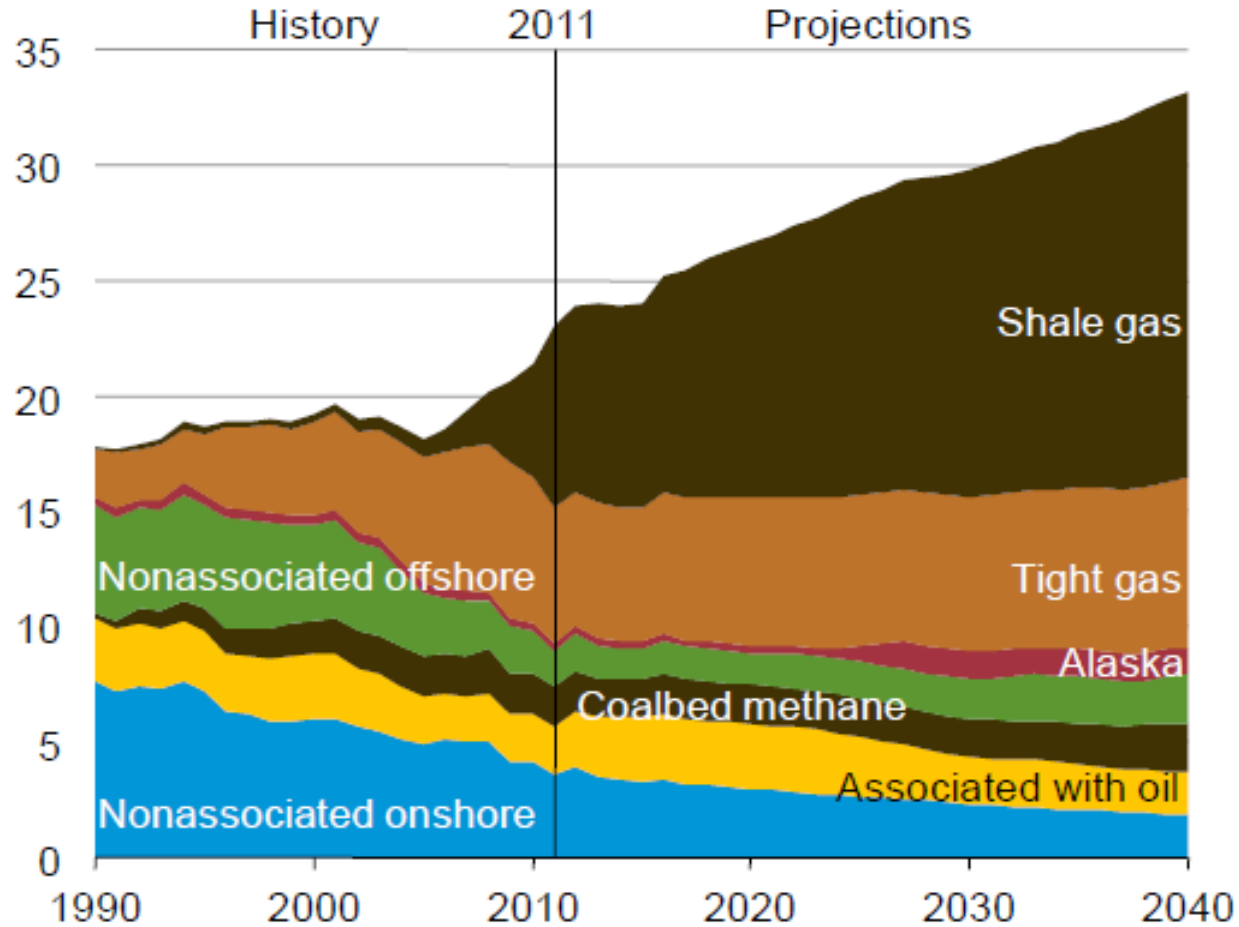
Extended Idle Reduction:

Simulation Type

- Single Configuration
 - Plot Output
- Multiple Configurations



US natural gas production



Volume and Range Comparison

Diesel



Tank Space
per 100 mi



15 Gal.

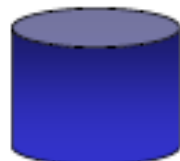
Range Per 100
Gallons Tank Space



650 mi

1

LNG



26 Gal.



380 mi

1/2

CNG



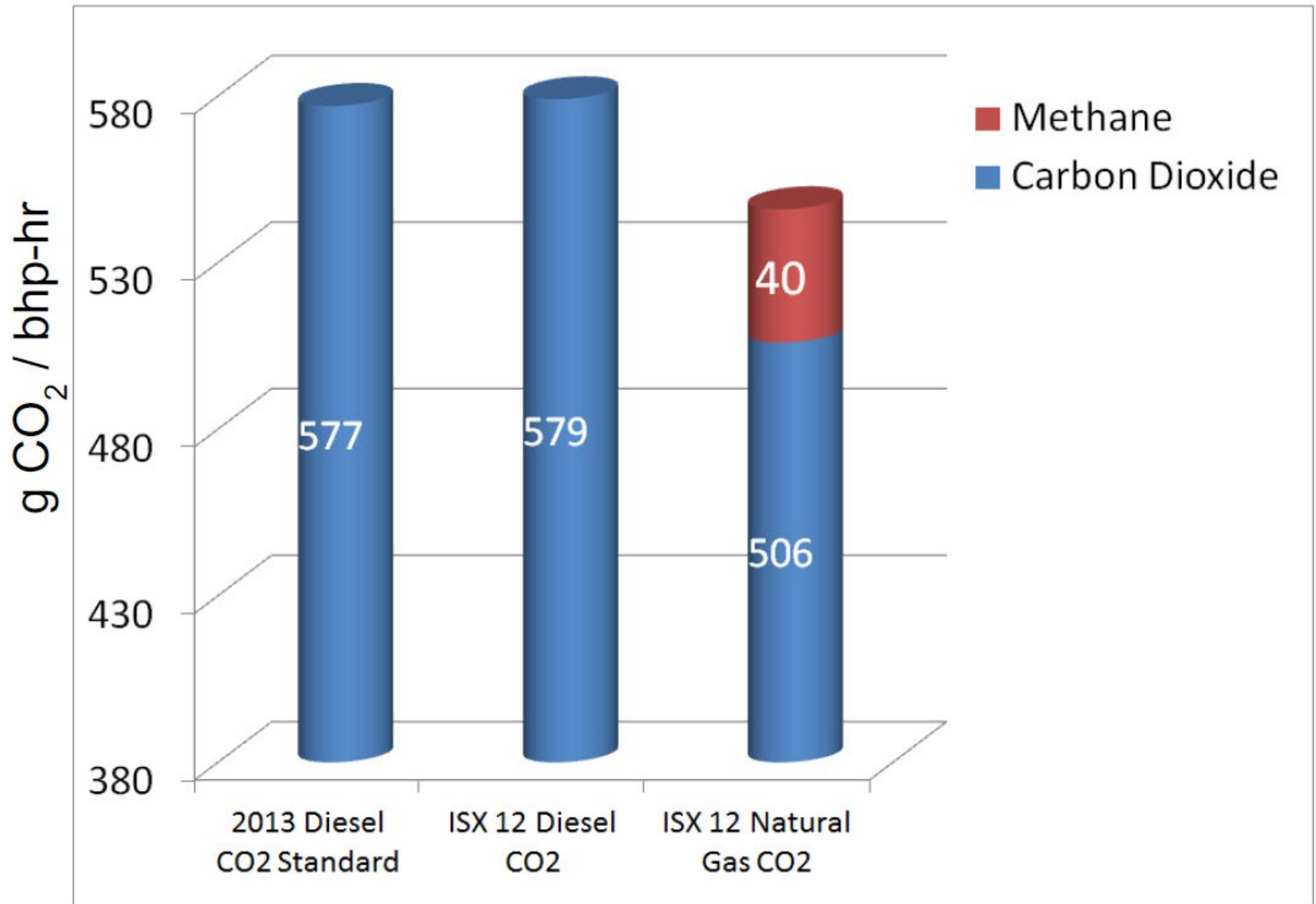
58 Gal.



170 mi

1/4





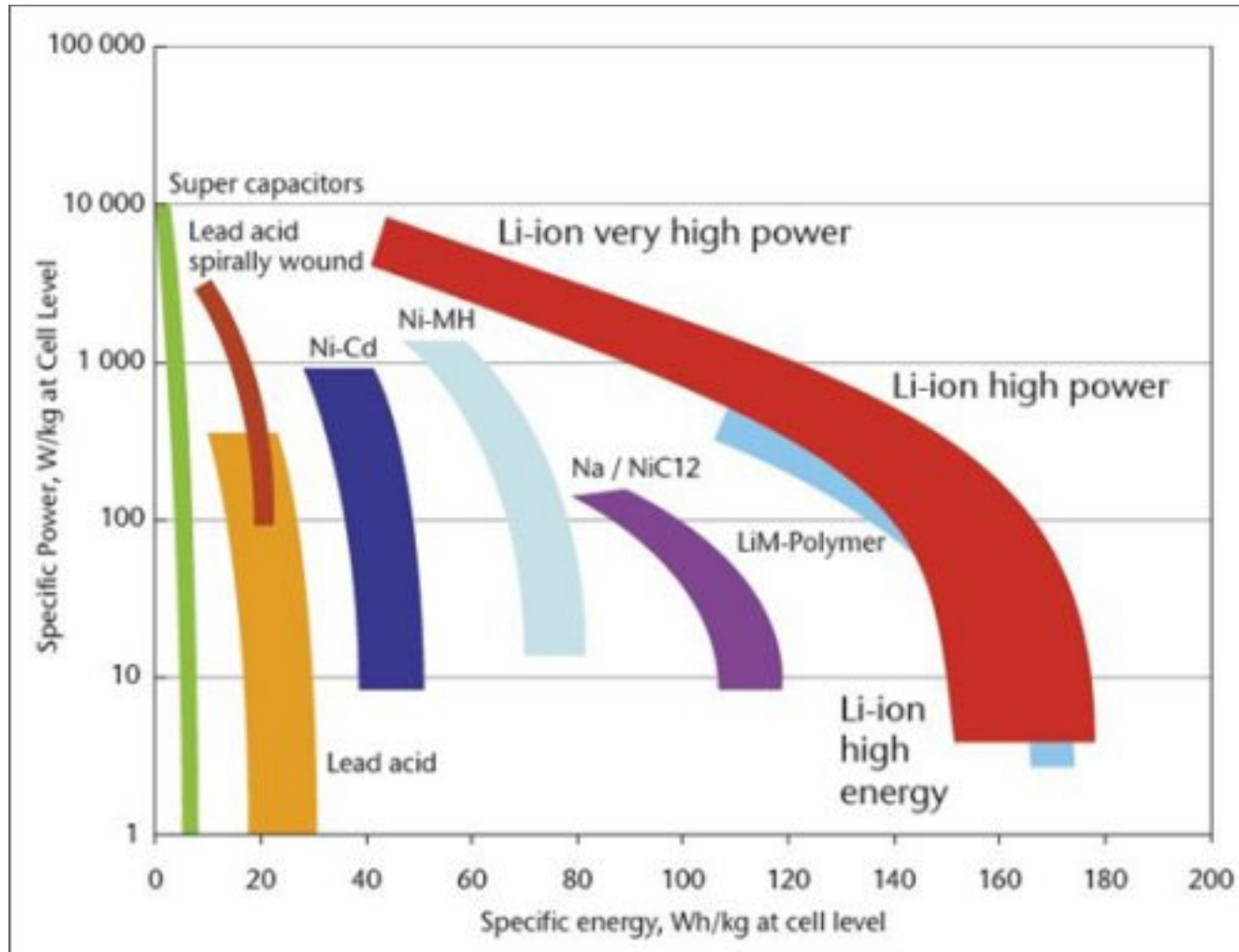
Hydraulic hybrid regenerative braking and launch

(Courtesy, Stored Energy Solutions)



Comparison of Battery Specific Power vs Energy

(Courtesy: NREL)



Batteries in Tesla Model S.



Over 7,000 Panasonic 18650 cells are integrated into the Tesla Model S battery pack

Future approaches to compliance

- Engine and driveline modeling has been proposed for compliance
- The integration of engines and transmissions and learning algorithms make it increasingly difficult to model drive lines
- The VW experience taught us the prescribed tests can be manipulated
- The future may rely on real time over-the-road monitoring of vehicle system performance

Conclusions

- Technology evolution and low cost natural gas is rapidly changing fuel strategies
- Low cost oil particularly in the US is preventing broader acceptance of alternative energy systems
- The US has very low tax on carbon fuels
- Present political climate in the US holds little hope of incentives for GHG reduction strategies
- Elsewhere in the developed world, GHG reduction is taken far more seriously



Thank You

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