More Sustainable Transportation: The Role of Energy Efficient Vehicle Technologies

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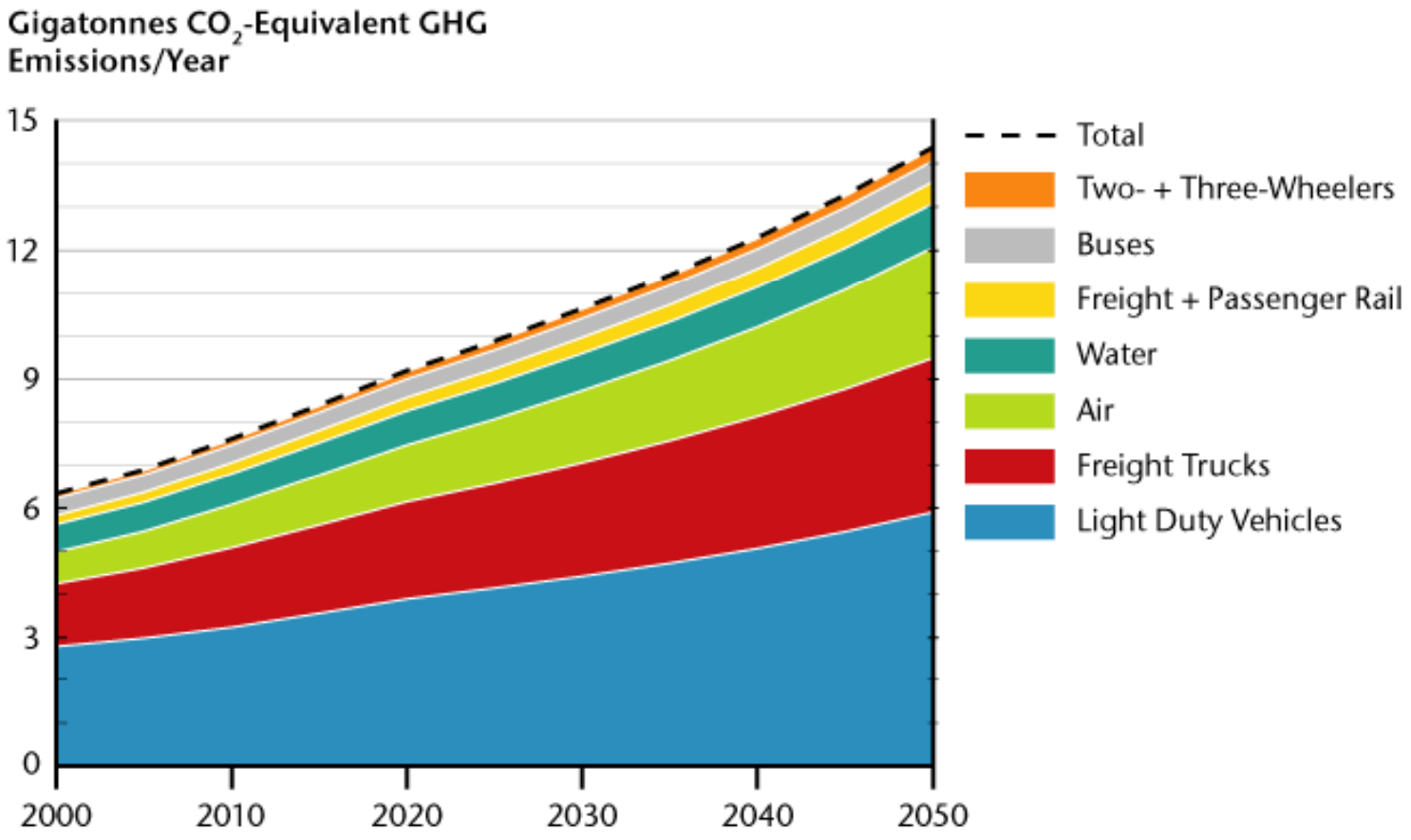
Summary Conclusions, with Explanations

1. Petroleum use and greenhouse gas emissions are increasing globally by about 2% per year due to steady growth in land and air, passenger and freight transportation demand.

Transport-related Well-To-Wheels CO_2 emissions by mode, 2000 - 2050

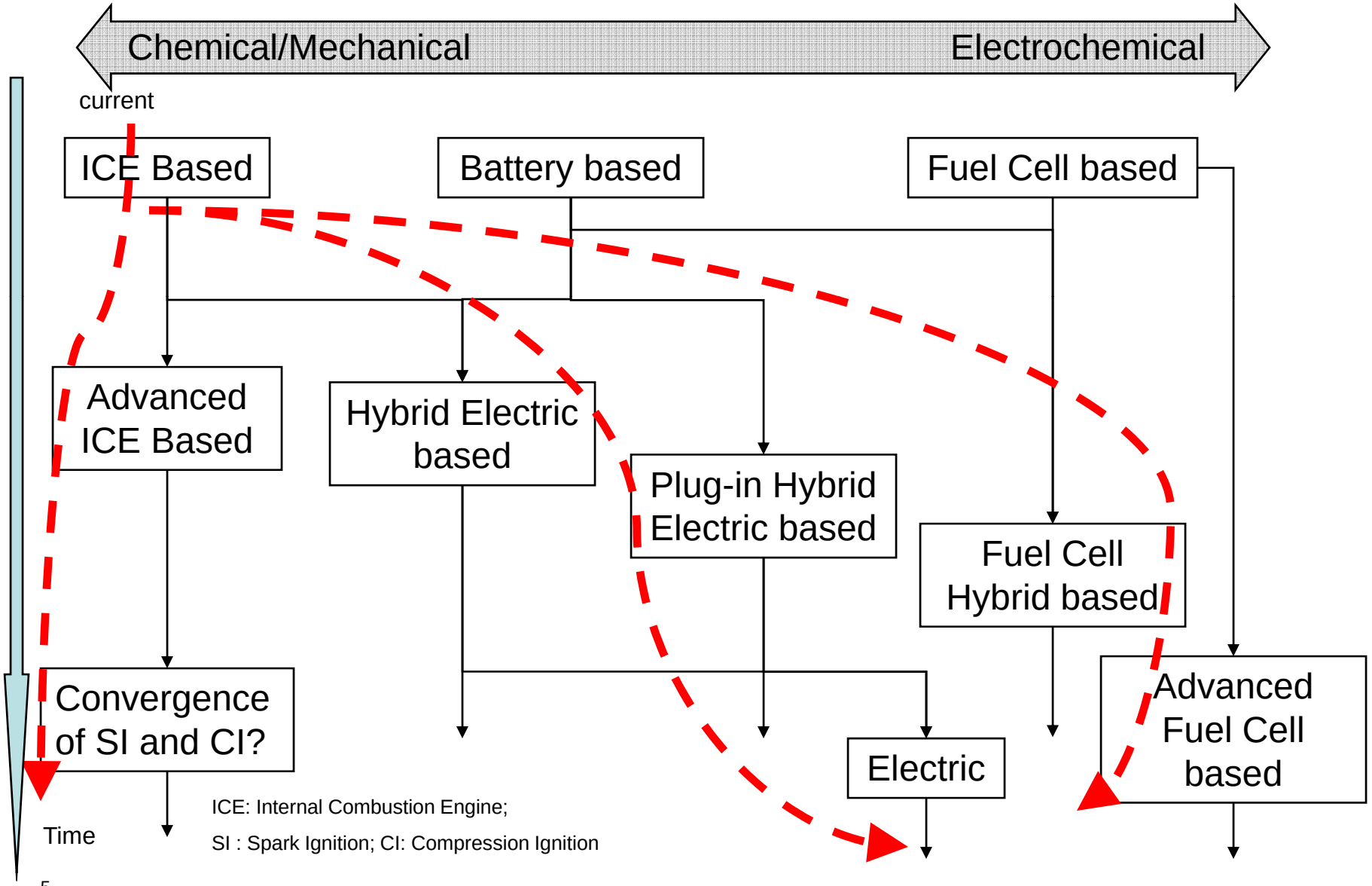


Source:
Sustainable Mobility Project calculations.

2. A 30-50% reduction in light-duty vehicle fuel consumption is feasible over the next 20-40 years, at increased cost. Such a reduction in fuel consumption can be achieved at constant performance by a combination of:

- Improved gasoline and diesel engines, and transmissions, in the nearer-term (20 years)
- Vehicle weight, size, tire resistance and drag reductions
- IC engine/electric hybrids in the mid-term
- Plug-in electric hybrids and hydrogen fuel cells in the longer-term (40 years)

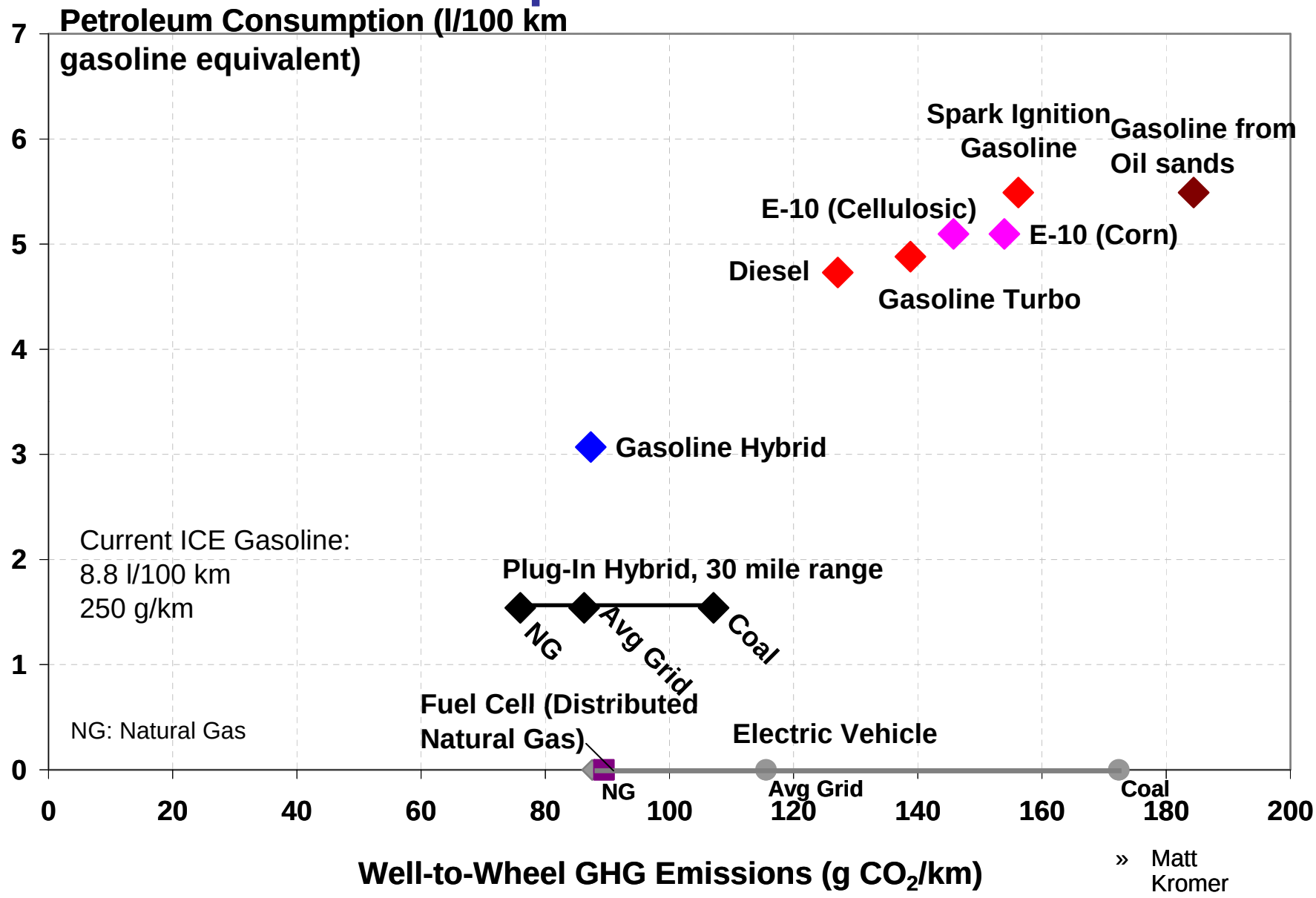
Evolution of a dominant vehicle powertrain system is uncertain in a carbon constrained world.



ICE: Internal Combustion Engine;

SI : Spark Ignition; CI: Compression Ignition

Well-to-Wheels Comparison of Future Powertrains



» Matt Kromer

3. Policies to reduce vehicle fuel consumption must recognize and then deal with the trade-off between vehicle performance, size (and weight) and fuel consumption.

   In the U.S., over the past 20-25 years, performance increases have dominated and average fuel consumption has not improved.

   In Europe, over the past 10 years, fuel consumption improvements have occurred in parallel with performance and weight increases.

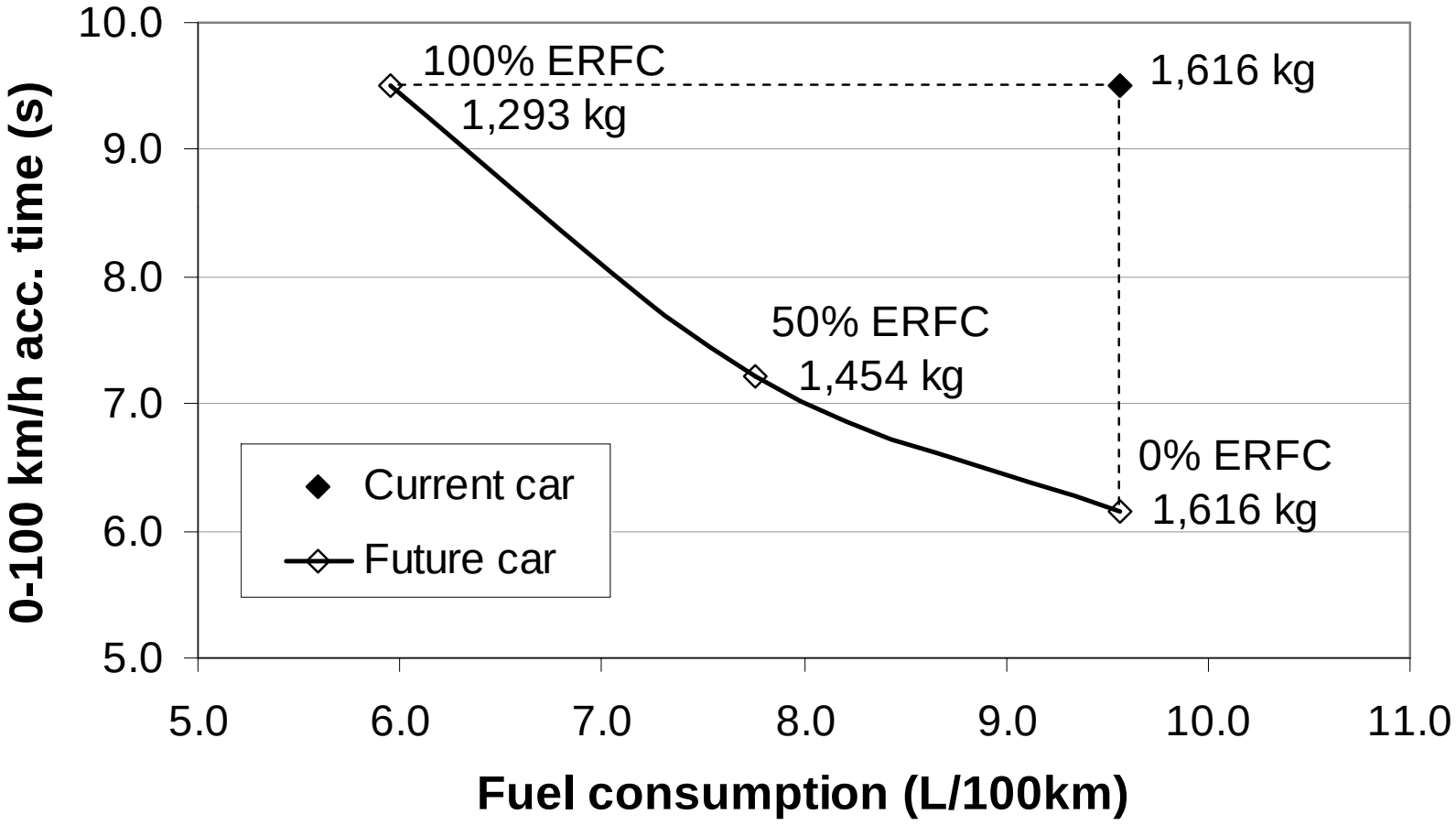
Fuel Consumption/Performance/Size Trade-Off

- A critical question is the extent to which the benefits of more efficienct technologies go to reduce actual fuel consumption.

- Quantify this with a ***degree of emphasis on reducing fuel consumption*** (ERFC).

$$\text{ERFC} = \frac{\text{Fuel consumption (FC) reduction realized}}{\text{FC reduction attainable with constant performance and size}}$$

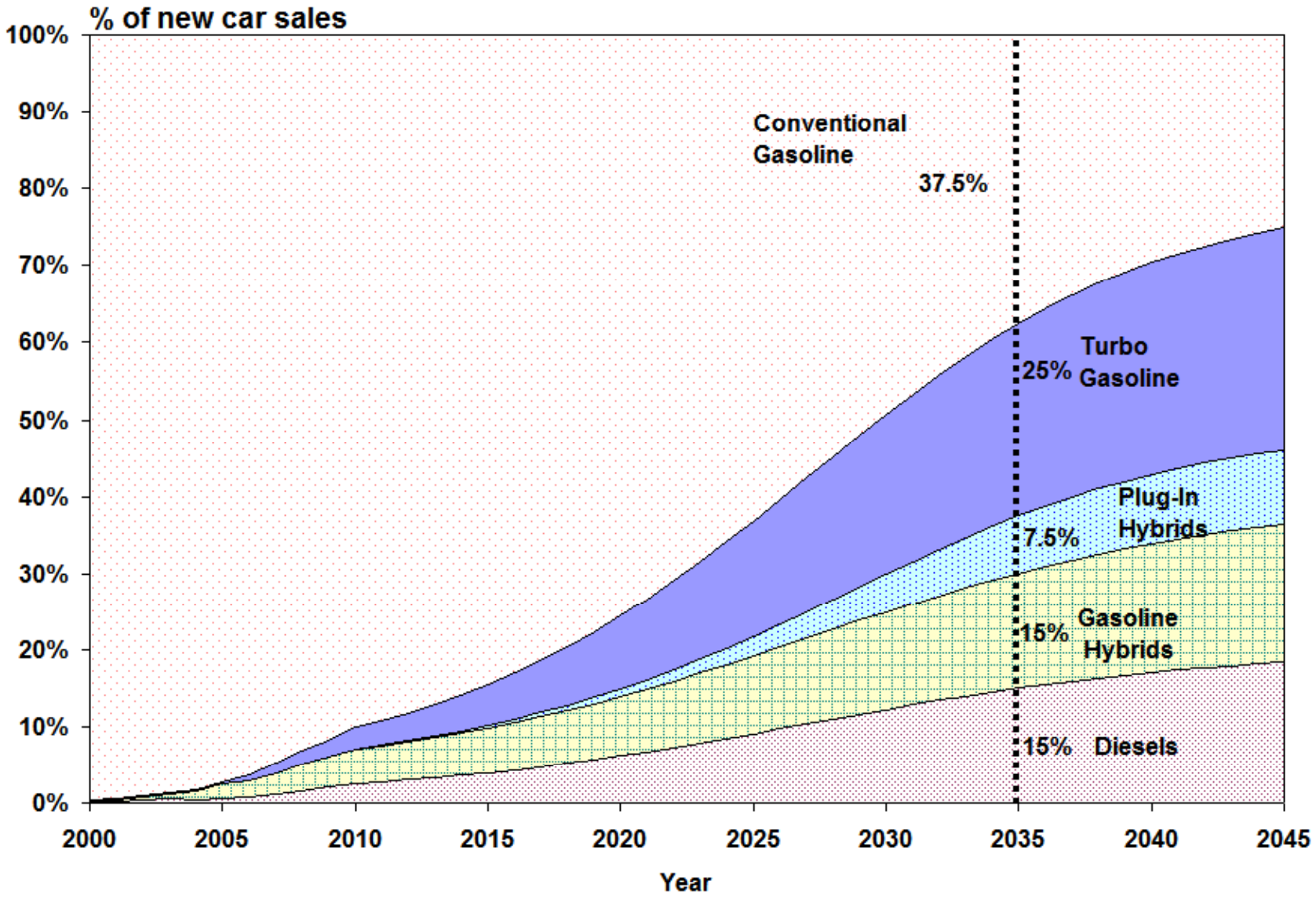
Trade-Off between Acceleration Performance and Fuel Consumption in the Average New U.S. Gasoline Car in 2035



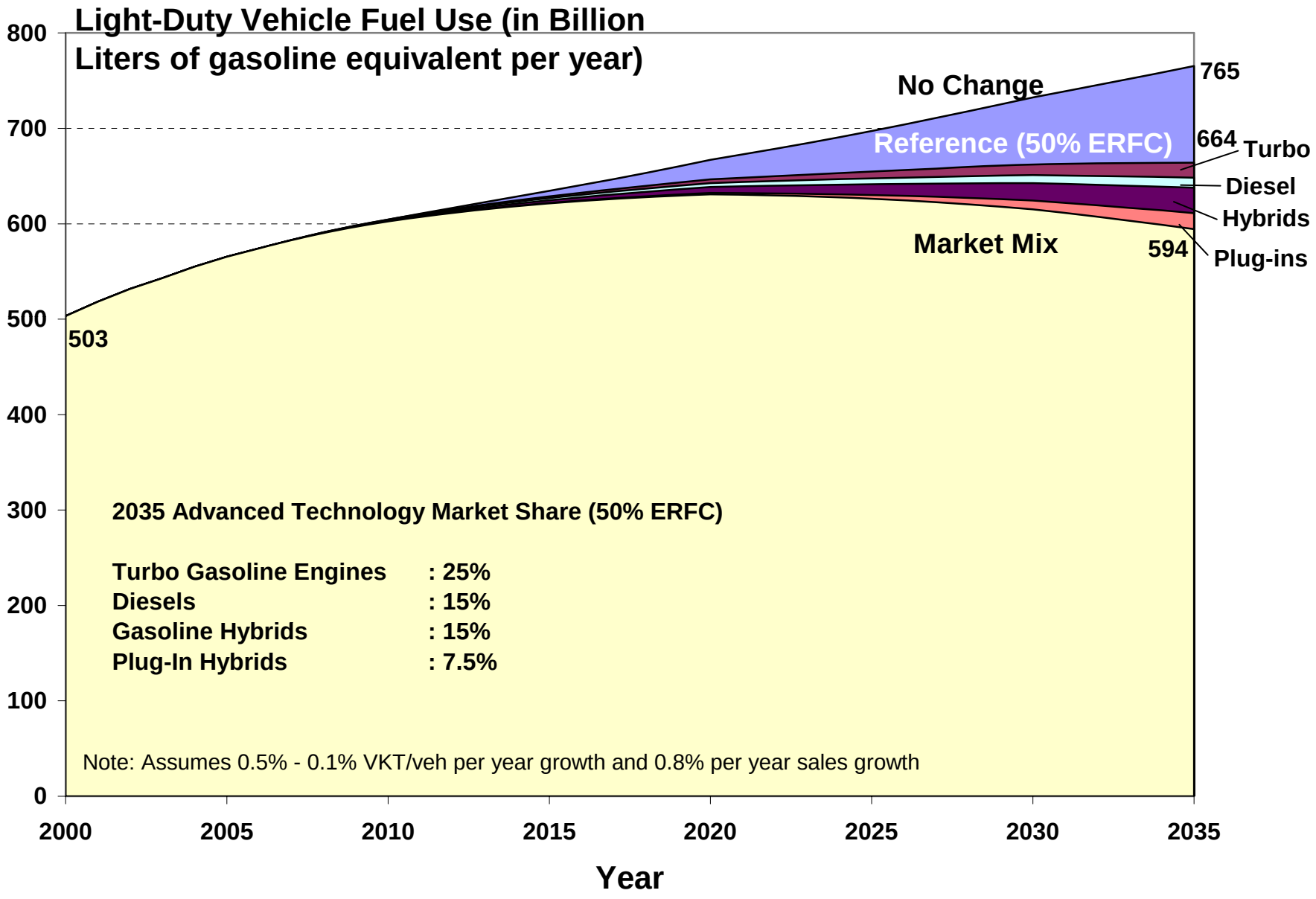
4. Due to slow rates of vehicle turnover in the in-use fleet, fuel consumption of mainstream technology vehicles will determine nearer-term fuel use and GHG emissions profiles. Directing the efficiency improvements towards reducing fuel consumption of high-sales-volume vehicle technologies is critical.

   Fleet studies are an essential tool in analyzing the impacts of various scenarios or strategies on fleet fuel consumption and GHG emissions.

Illustrative Example for U.S.: Many Technology Scenario



U.S. LDV Fuel Use: Many Technologies Scenario



5. Due to high initial cost and strong competition from mainstream gasoline vehicles, U.S. market penetration rates of low-emissions diesels, and gasoline hybrids are likely to be slower than is widely believed. Thus, in the U.S., diesels and gasoline hybrids have only a modest, though growing potential for reducing fleet fuel use before 2025.

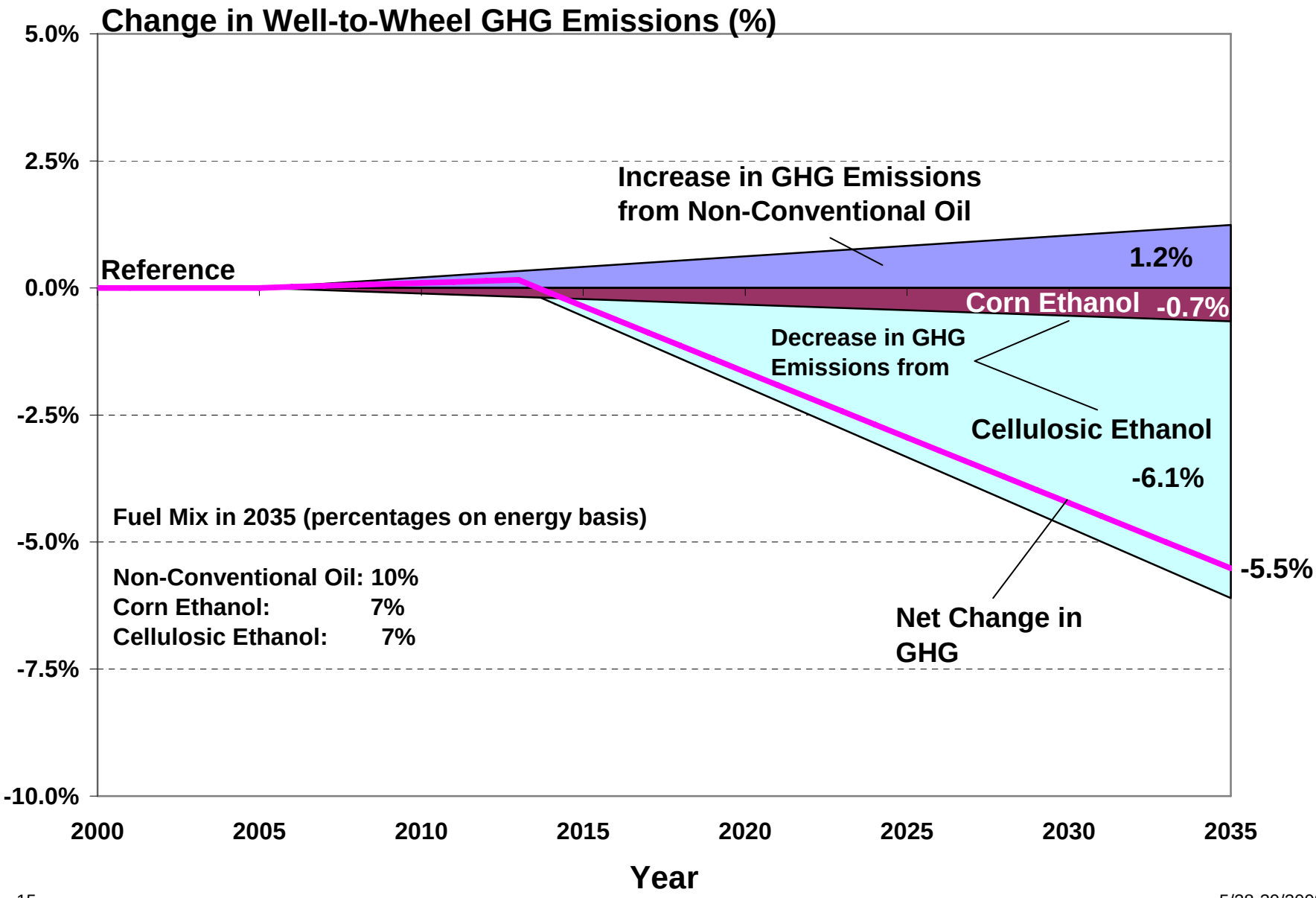
6. In the longer-term, the impact of steadily increasing sales of advanced technology vehicles will be far larger than their near term impact. Since the time-scales to impact of new automotive technologies are long, advanced vehicle technology introduction needs to start as soon as possible.

7. A greater number of vehicle and fuel alternatives are available to displace petroleum use than to reduce greenhouse gas emissions. Policy efforts should focus on measures that improve both energy security and carbon emissions at the same time.

- Plug-In Hybrids could have a major impact on reducing petroleum use, but (for U.S. electricity generation mix) GHG reductions similar to plug-ins can be achieved by gasoline hybrids at lower cost.

- Increasing the biomass-to-liquid fuel supply might help reduce well-to-tank GHG emissions, but increased use of non-conventional oil is likely to negate much of this impact.

Low Oil Sands and High Ethanol Scenario



Energy and Greenhouse Gas (GHG) reductions from transportation is a daunting task.

1. Placing much greater emphasis on reducing fuel consumption rather than improving vehicle performance would lower the required market penetration rates of advanced vehicle technologies to achieve significant reductions in fuel use and greenhouse gas emissions.

2. Directing the efficiency improvements towards reducing the actual fuel consumption of high-sales-volume vehicles is critical to achieve nearer-term impact.

3. Reducing average vehicle weight and size will also be important.

4. Sustained policy efforts that go well beyond current incentives during the initial market introduction of advanced propulsion systems and fuels will be needed to achieve significant reductions in light-duty vehicle fleet fuel use.

5. Policy initiatives should be focused on measures that rapidly improve both energy security and carbon emissions at the same time.