

| reduce emissions |

| improve fuel economy |

| lower operating costs |

## Hybrid Electric School Bus Project

# EARLY PRODUCTION PURCHASE



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## Project Overview

- National project funded by Department of Energy and other agencies
- Administered by Advanced Energy
- Phase 1: Feasibility and Outreach
- Phase 2: Multiple State Demonstration
- Phases 3 and 4: Fleet Testing and Market Deployment



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## Buyers Consortium

- Need to demonstrate demand to interest a manufacturer
- Consortium will:
  - Develop RFP and Specifications
  - Locate additional funding sources
- Early Production Purchase of approximately 20 buses



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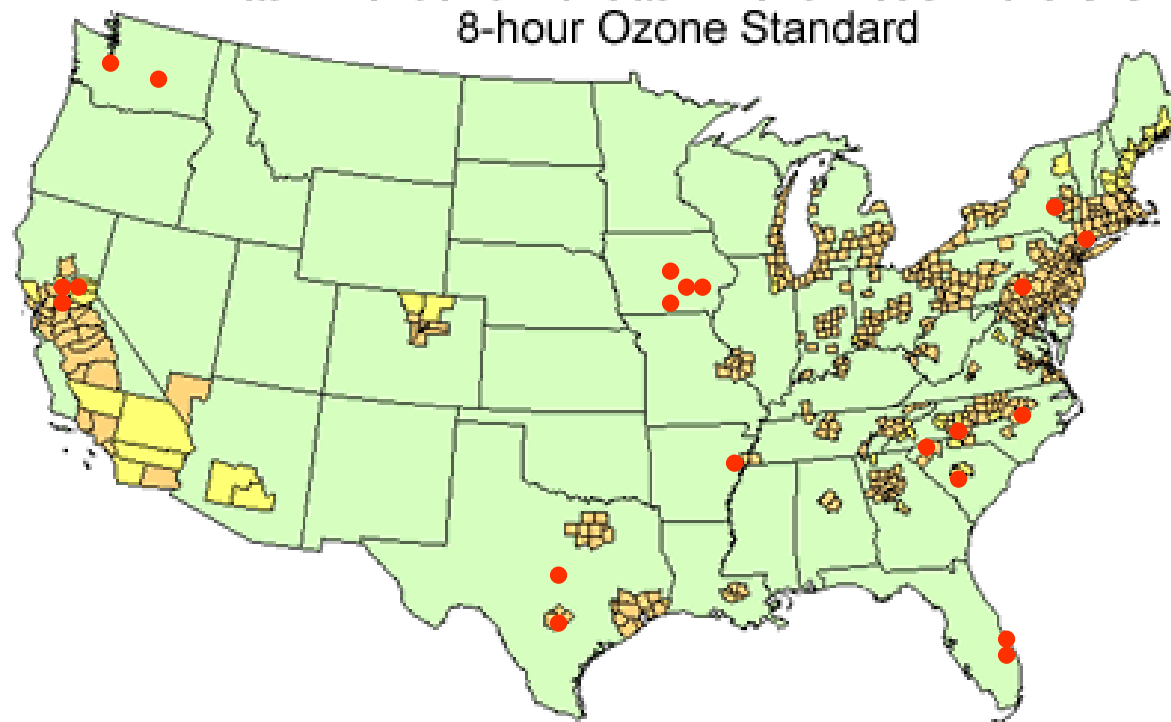
## Hybrid Electric School Bus Project

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- Florida (2)
- South Carolina (2)
- North Carolina (2)
- Pennsylvania (1)
- New York (2)
- Iowa (4)
- Arkansas (1)
- Texas (2)
- California (3)
- Washington (2)

Attainment and Nonattainment Areas in the U.S.  
8-hour Ozone Standard



- Attainment (or Unclassifiable) Areas (2668 counties)
- Nonattainment Areas (432 entire counties)
- Nonattainment Areas (42 partial counties)



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## What is a Hybrid?

- Hybrid electric combines electric motor with combustion engine
- Regenerative braking allows energy recovery



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## What is a Plug-in Hybrid?

- Plug-in can receive a portion of battery energy from grid
- Categorized by all electric range
- Plug-In is optional



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# Why Plug-in Hybrid Electric School Buses?

- Significant emission reductions
  - Reduces NO<sub>x</sub> by ~60%
  - Reduces PM by ~95%
  - Reduces CO<sub>2</sub> by ~30%



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# Why Plug-in Hybrid Electric School Buses?

- Increased energy efficiency
- Reduced engine maintenance
- Lifecycle costs are approximately equal to conventional diesel bus



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## What are the program costs?

- Initial Cost: > standard diesel
- Operating Cost: < standard diesel
- Lifecycle Cost = standard diesel
- Infrastructure
  - Same diesel pumps
  - Same maintenance garage
  - Electric plug-in chargers

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Hybrid Electric School Bus Project

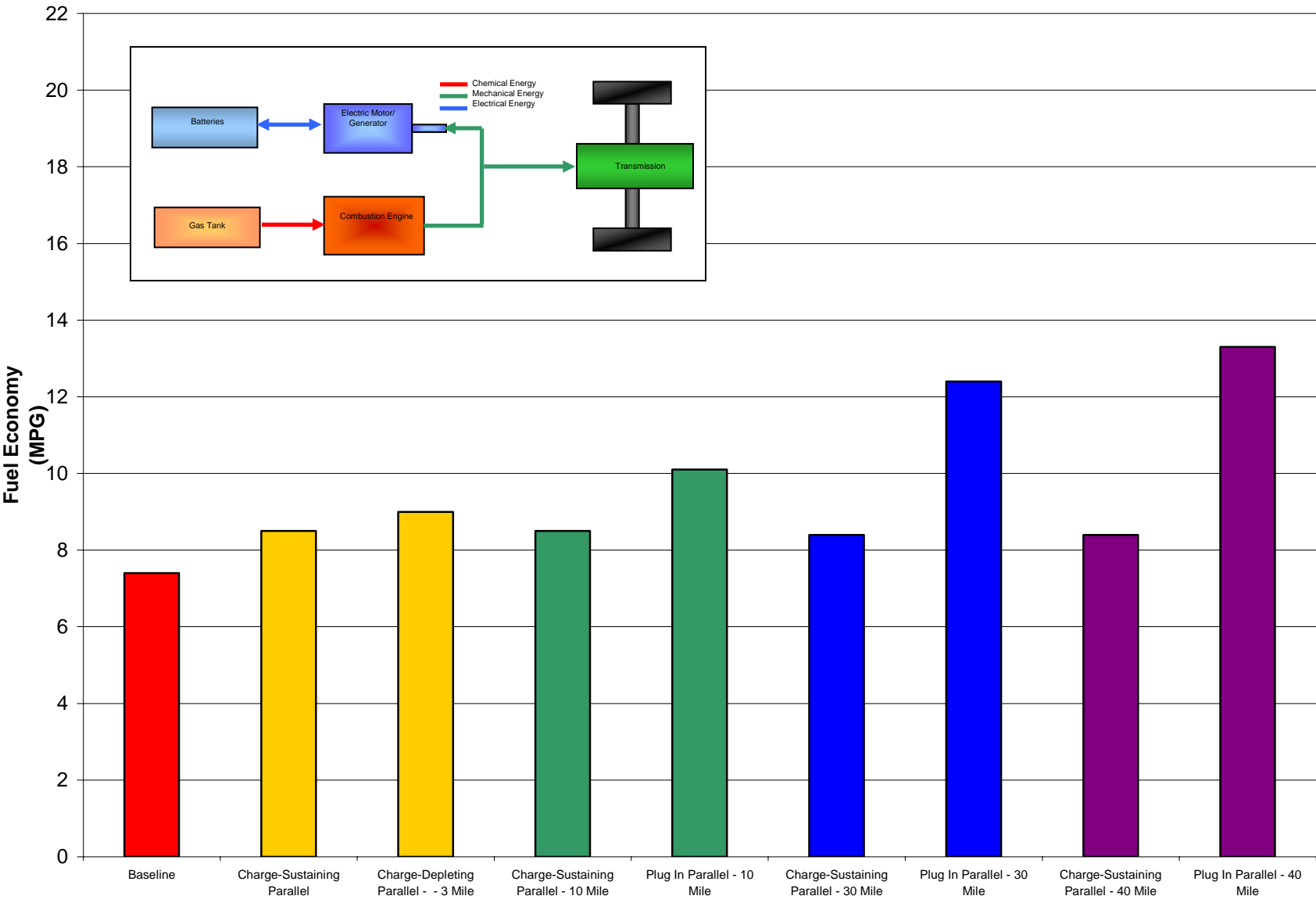
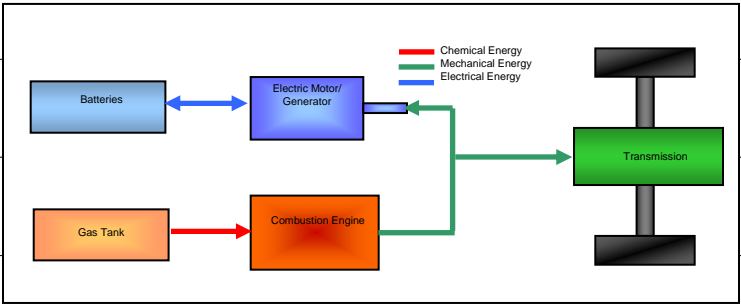
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## 10 Year Effort (2003-2013)

- 4 Phases
  - I. **Feasibility Study (2003-2005)**
  - II. Prototype Operation and Testing
  - III. Fleet Operation
  - IV. Full Deployment

ADVISOR  
Modeling of  
Plug-In Hybrid  
Electric School  
Buses

# Parallel Hybrid Fuel Economy



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# Hybrid School Bus Program

- We have shown demand to the manufacturers
- We have 21 buses represented on the buyers consortium
- We currently have funding for 11 of those buses
- The manufacturers have responded that they (Thomas and International) will respond
- The critical question now is “How much hybrid can we get?”



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