

## Global Warming Solutions for California Cars

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## Methodology

- **Baseline emissions**
  - Based on certification data
  - CH<sub>4</sub> and N<sub>2</sub>O estimated from relationship with NO<sub>x</sub> and NMOG
  - Refrigerant and indirect CO<sub>2</sub> emissions estimated
- **Modeling**
  - Modal Energy and Emissions Model (MEEM)
  - Modeled 2 packages of technology
- **Technology cost estimates**
  - Literature survey - values used based on Plotkin, Greene, and Duleep (2002)

## Today's Technology

- **Engine improvements**
  - Variable valve lift and timing
  - Cylinder deactivation
- **Transmission improvements**
  - 6-speed AT
- **Air conditioning improvements**
  - Enhanced HFC-134a system
- **Vehicle load reduction**
  - Aerodynamic drag reduction
  - Rolling resistance reduction

## Advanced Technology

- **Engine improvements**
  - Advanced stoichiometric direct-injection
  - Cylinder deactivation
- **Transmission improvements**
  - 6-speed AT without a torque converter
- **Air conditioning improvements**
  - HFC-152a air conditioning system
- **Vehicle load reduction**
  - Further aerodynamic drag reduction
  - Further rolling resistance reduction
- **42 Volt integrated starter generator - idle off**

## Large Car Results

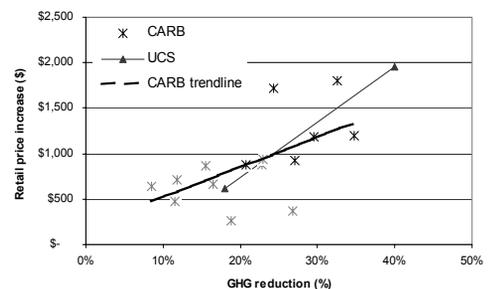
Base vehicle: 2003 V6 Toyota Camry

	Today's technology	Advanced technology
Base Emissions* (g CO <sub>2</sub> -eq/mi)	334.2	334.2
Modeled Emissions (g CO <sub>2</sub> -eq/mile)	270.8	196.8
Reduction (%)	19%	41%
Retail price increase (\$)	\$620	\$1,960
Payback time (years) <sup>†</sup>	3.9	4.8

\*Adjusted to include CH<sub>4</sub>, N<sub>2</sub>O, HFC-134a, and indirect a/c emissions

<sup>†</sup>Calculated using EMFAC VMT, 16 year life, 5% discount rate (real)

## UCS and CARB Large Car Results



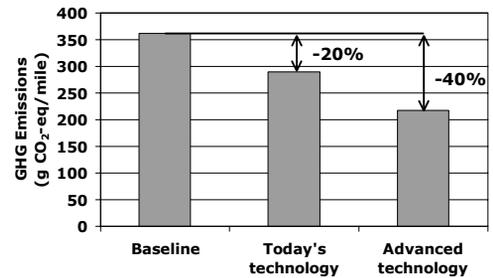
\*Includes CARB near- and mid-term technologies, no hybrids

## Other Vehicle Classes

	Small car*	Minivan	SUV	Pickup Truck
Base emissions (g CO <sub>2</sub> -eq/mi)	292.9	368.6	440.0	487.1
Today's Technology				
Reduction (%)	18%	18%	24%	21%
Payback time (yrs)	3.8	3.8	1.9	2.3
Advanced Technology				
Reduction (%)	39%	36%	43%	39%
Payback time (yrs)	5.2	5.1	3.2	3.5

\* CVT used rather than 6 speed A/T in both cases, no cylinder deactivation

## Fleet reductions



\*Estimated using fleet mix data from CALCARs

## Conclusions

- Technology is available to reduce emissions
- Reductions are cost effective to the California consumer
- Results from CARB, UCS, and others support strong standards for California's new passenger vehicle fleet