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Clean Transportation & Alternative Fuels Issues of Today and Tomorrow

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Clean Transportation Today and Tomorrow

Takeaways:

- Clean Transportation Solutions Are Needed – Environment, Economy
- Government Policies are Moving the Ball Forward, Slowly – More Can and Needs to be Done
- Technology is Advancing at a Rapid Pace, but there is No Silver Bullet
- Technology Will Not Save the Planet – Leaders Will

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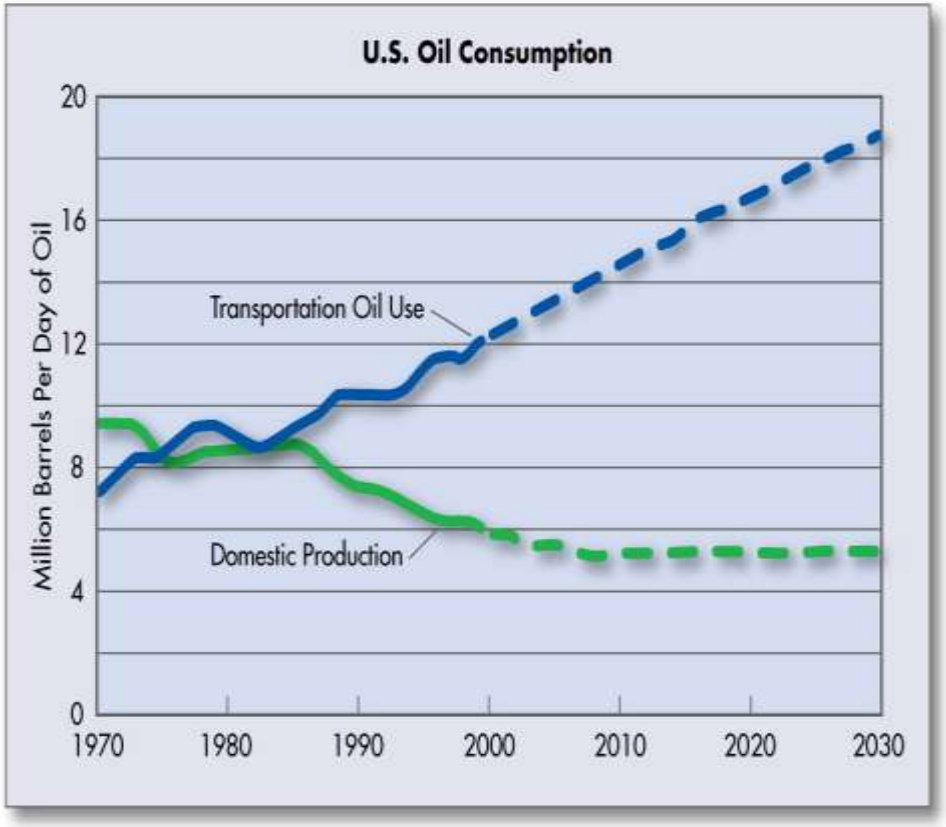
WHY DO WE NEED CLEAN ALTERNATIVE FUEL TRANSPORTATION?



Petroleum Dependence and Energy Security

- Globally, consumers appetite for energy is expected to grow 54% by 2025 lead by increasing demand from China and India
- Oil is expected to remain the dominant energy source worldwide through 2025, domestic reserves are declining
- U.S. oil imports are projected to increase almost 40% by 2025, imports will equal almost 70 % of demand
- Transportation (cars, trucks and buses) consumes two thirds of all oil used in the U.S.
- All other energy sectors have diversified while transportation is still 95-98% reliant on petroleum products- gasoline and diesel

Facts taken from the EIA report on World Energy

WHY DO WE NEED CLEAN ALTERNATIVE FUEL TRANSPORTATION?

Over 90% of Californians Breathe Unhealthy Air at Times

Days Over State 24-Hour PM10 Standard

Source: ADAM September 2006 (tfn)

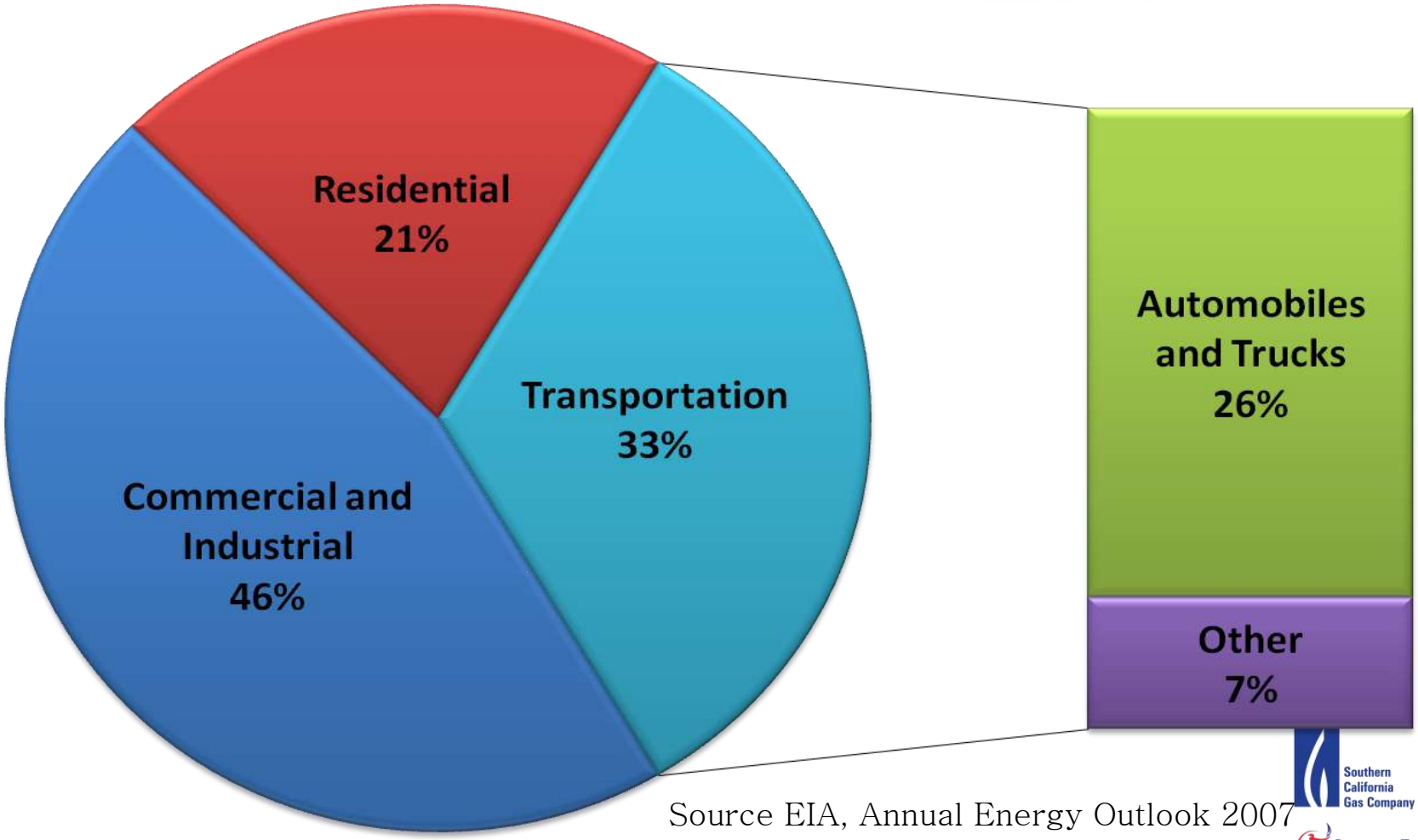
Days Over State 8-Hour Ozone Standard

Source: MRedgrave May 2006 (mln)

0-5 Days **6-50 Days** **50-100 Days** **>100 Days**

The Carbon Issue and Transportation

US National Statistic:



Source EIA, Annual Energy Outlook 2007

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Clean Transportation Federal Policy

FEDERAL POLICY ON CLEAN TRANSPORTATION

- HISTORICALLY
  - ENVIRONMENT AND EFFICIENCY FOCUS
  - TAXES, GRANTS AND REBATES
- CURRENT TRENDS AND FUTURE POLICY
  - GHG REDUCTION FOCUS
  - LOW CARBON FUELS
  - INCREASING EFFICIENCY STANDARDS
  - MARKET MECH/ POSSIBLE
  - ENERGY SECURITY

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Clean Transportation California Policy

CALIFORNIA STATE POLICY ON CLEAN TRANSPORTATION

- HISTORICALLY
  - LEADERSHIP
  - ENVIRONMENTAL FOCUS THROUGH TAILPIPE STANDARDS AND FLEET MANDATES
  - INCENTIVE PROGRAMS

- CURRENT TRENDS AND FUTURE POLICY
  - CARBON, CARBON, CARBON…
  - LOW CARBON FOCUS
    - AB 32, LCFS AND CARBON CRED MARKETS
  - BOND MEASURES – STRONG VOTER APPROVAL
  - CHALLENGE FEDERAL AUTHORI

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Clean Transportation Technology

Select Technology Solutions to Transport Sector GHG

- Natural Gas Vehicles
- Hybrid Electric Drive Vehicles
- Fuel Cell Vehicles

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Clean Transportation Technology – Natural Gas Vehicles

Benefits:

- Known technology, improvements made over time
- Applications from light duty to heavy duty
- Lower NOx, SO2, PM
- 15 - 20% lower CO2 depending on pathway
- Two Forms of Delivery:
  - CNG – Compressed Natural Gas
  - LNG – Liquefied Natural Gas

Current and Future Trends:

- Heavy Duty Port Drayage – significant air quality, GHG and fuel savings
- Hydrogen CNG, or HCNG Blends – 30-50% NOx reductions, Transits
- Medium Duty Goods Movement - significant air quality, GHG and fuel savings
- School Bus Market – no diesel PM, fuel savings

Limitations:

- Refueling Infrastructure
- Lack of Available Product – Most OEMs manufacture for overseas markets, not domestic

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Market Promise of the PHEV

- Solves electric vehicle range problem
- PHEV builds on already market-accepted hybrid vehicle technology
- No infrastructure changes required—standard residential outlet for charging
- Off-peak "valley fill" charging would increase load factors and electricity production efficiency
- Reduces petroleum consumption and adds more diversity to transportation fuel mix

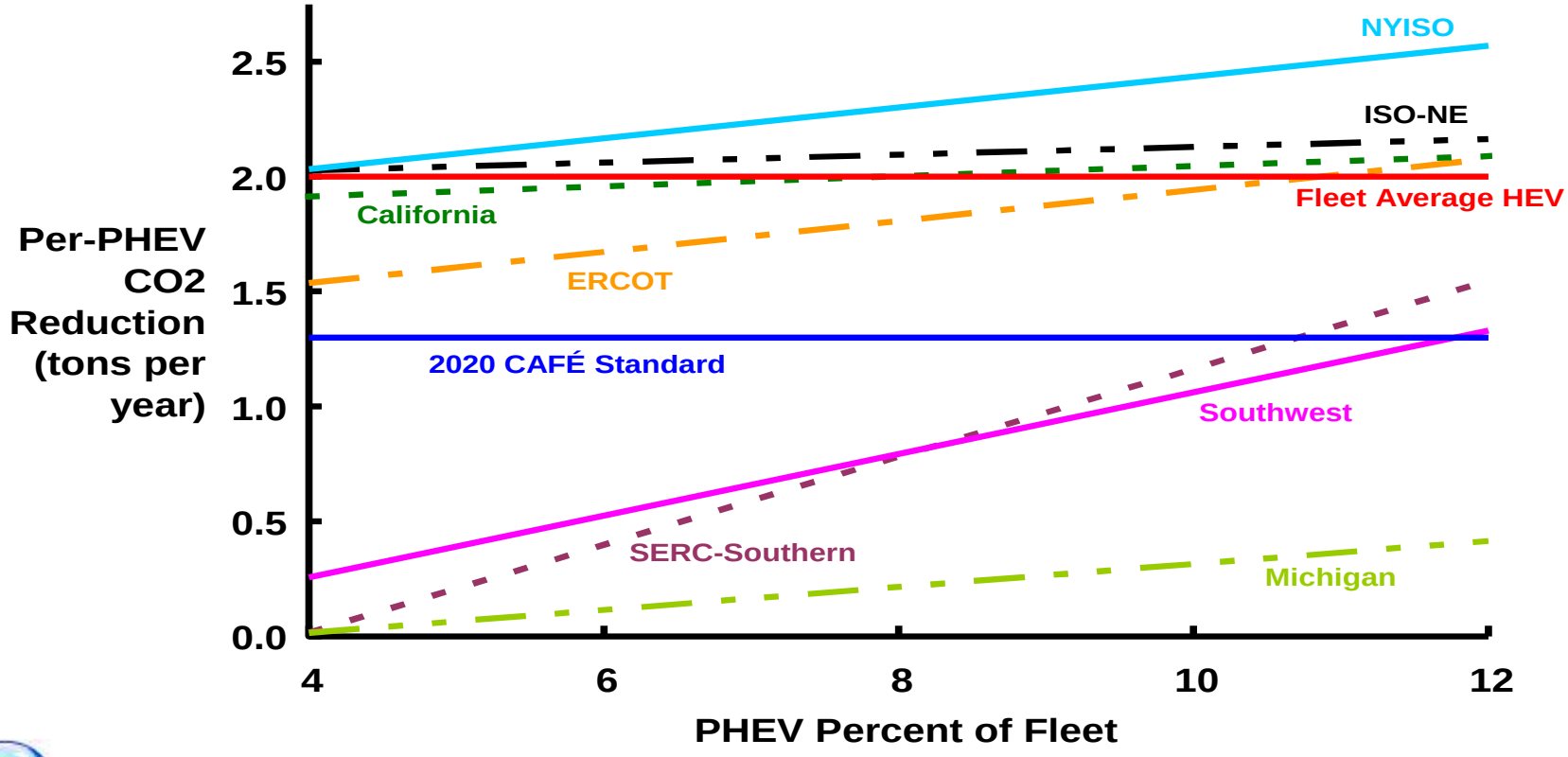
- CO_2 reductions depend on regional power generation fuel mix
- Emissions shift from transportation sector to power sector
- Plugging in requires behavior change
- Recharging access limitations for city-dwellers with on-street parking

- Significant projected PHEV cost premium versus standard gasoline vehicles
- Battery durability, life, and safety still not proven in the field
- Disposal issues?

Source: Cambridge Energy Research Associates.

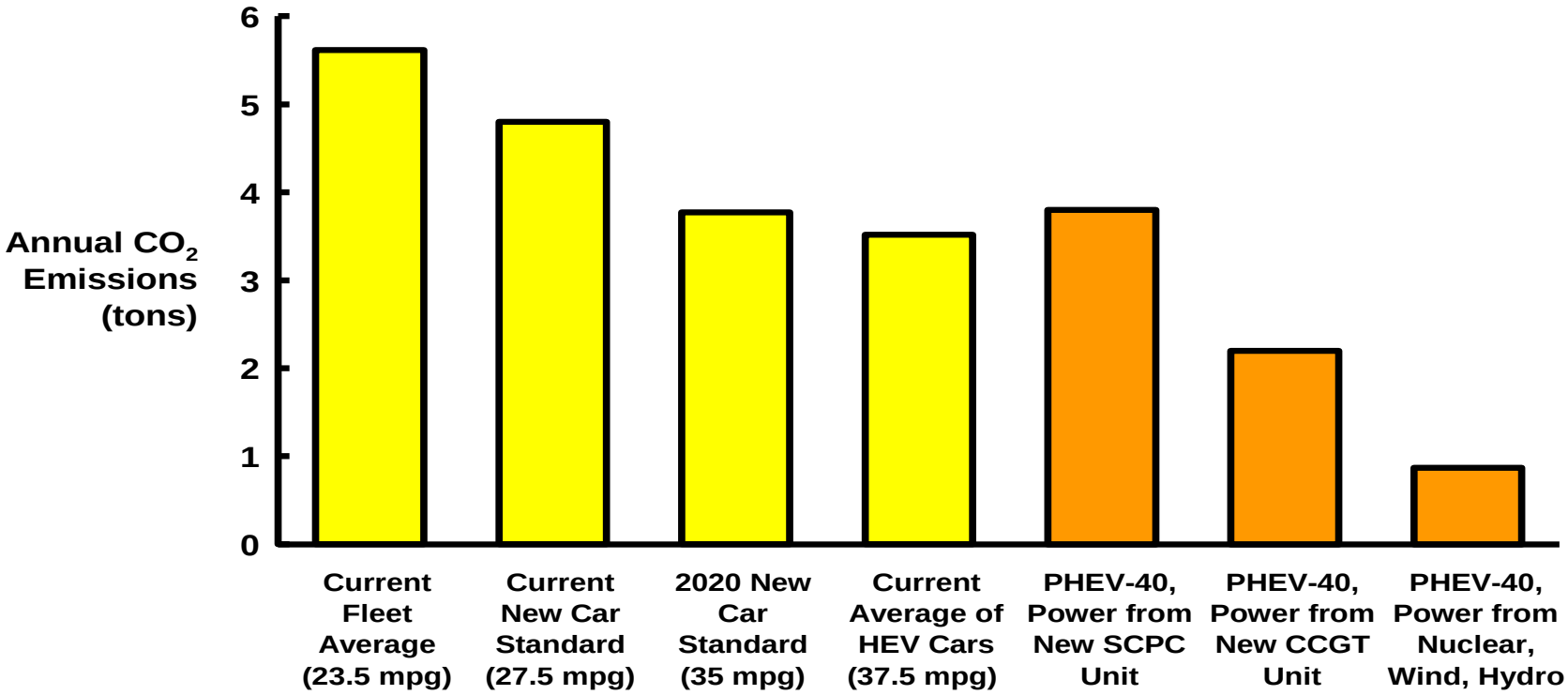
PHEV MODERATE AND HIGH ADOPTION RATE SCENARIOS:

Per-vehicle CO_2 Reduction versus Market Penetration for Selected US Regions



Source: Cambridge Energy Research Associates.
*Per-vehicle CO2 savings of roughly 1.3 tons per year is the equivalent benefit of the 2020 CAFÉ standard of 35 mpg as compared with the 2020 fleet average. Per-vehicle savings for 2020 fleet average HEV car as compared to overall 2020 fleet average is roughly 2.0 tons per year.
PHEV Charts

US Passenger Cars—Carbon "Tire Tracks"



Based on 15,000 annual miles driven; supercritical pulverized coal (SCPC) unit heat rate is 8,900 Btu per kWh; natural gas–fired combined-cycle unit heat rate is 7,000 Btu per kWh; PHEV assumes 67 percent of miles traveled in electric mode and 50 mpg gasoline hybrid mode efficiency; current fleet includes a mix of large, mid-size, and compact cars; mileage based on current EPA standards

Source: Cambridge Energy Research Associates.
PHEV Charts

Clean Transportation Technology – Hydrogen Fuel Cell Vehicles

Hydrogen is viewed by many as the future of transportation fuel

Benefits:

- Clean, Clean, Clean
- Zero emissions from the tailpipe
- Hydrogen production using renewable energy is among the cleanest solutions available

Current and Future Trends:

- Increased focus on renewable hydrogen production, and carbon sequestration, life cycle issues
- Transits are experimenting with fuel cell buses

Limitations:

- Costly fuel, and boil-off
- Lack of Widely Available Product – very limited production and availability
- Limited refueling infrastructure

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What's the Right Fix?
Combination of Policy and Technology

Effective Policy Solutions

- Fuel Supply - Low Carbon Fuels Standard, Increased Alt Fuels Penetration
- Investment - Tax Incentives
- Regulatory Certainty - Clear Targets or Mandates
- Technology Forcing Standards - Aggressive CAFÉ
- Cut Pork Barrel Subsidies – Ethanol Tariff
- Credit Trading Markets?

Technology

- Diversity of Clean Fuel Product – Hybrids, Battery Electric, Natural Gas, Fuel Cell
- Fuel Diversity – Electricity, Natural Gas
- Targeted Research – Biogas, Hydrogen, Cellulostic Ethanol

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THIS IS YOUR WORLD
MAKE A DIFFERENCE
IT'S UP TO YOU

THANK YOU!