Building a Future with Biofuels

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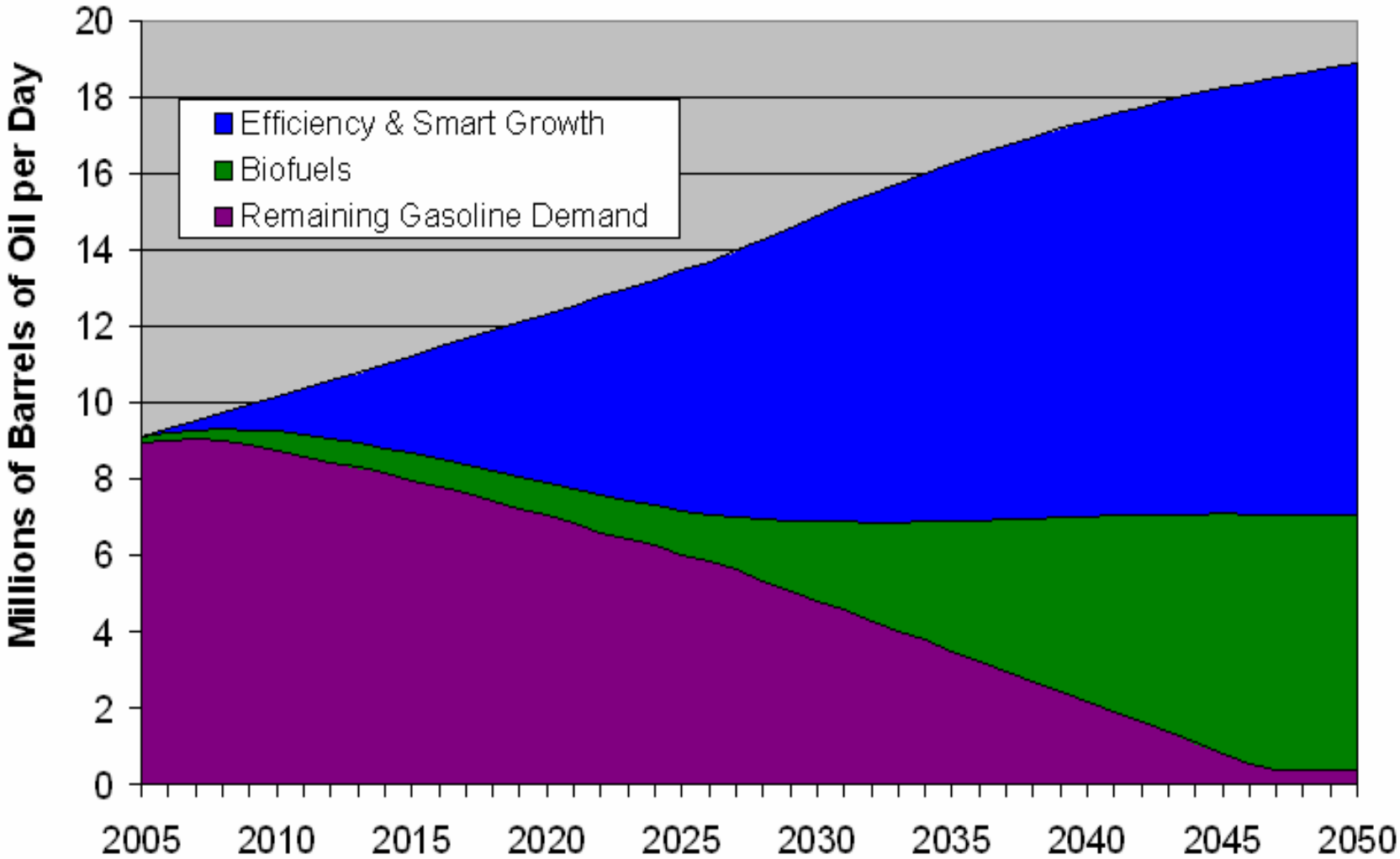
Why biofuels?

- Threats:
  - Global Warming
  - Unhealthy Air
  - Oil Dependence

- Solutions: *No Silver Bullet*
  - Efficiency, VMT reduction
  - Clean, low-carbon fuels
    - Biofuels, Electricity, Hydrogen

Biofuels + Efficiency = No Gasoline Demand in 2050?



NRDC, *Growing Energy*, 2004.

Biofuel Opportunities

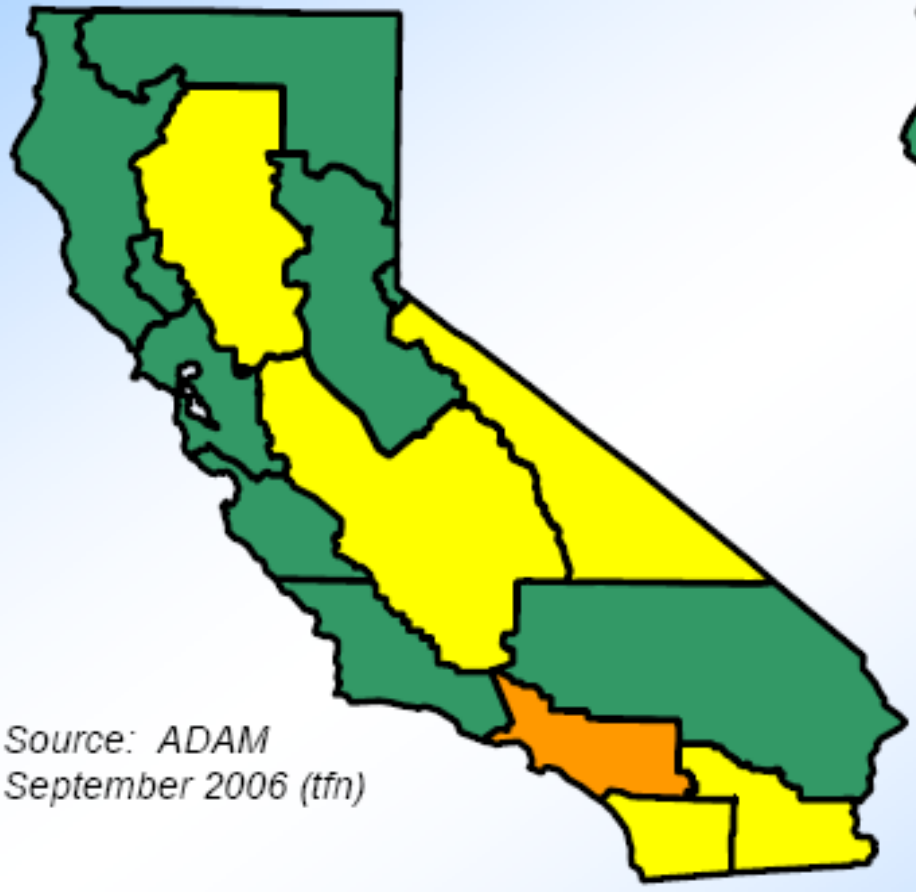
- E85
  - Sustainable, cellulosic feedstock
  - Transportation fuel vs. additive
- Biodiesel
  - Low blends
  - Targeted high blends

Biodiesel

- Limited oil displacement
- NOx emissions need to be mitigated
  - Low blends: oil displacement strategy without significant air quality benefits
    - Greater testing of emissions needed
    - CA legislative approach (AB 1675, Kehoe, not passed): Starting at 2%, verify air quality is not harmed before moving to 5% or higher.
  - High blends: Potential benefits in certain applications, such as marine

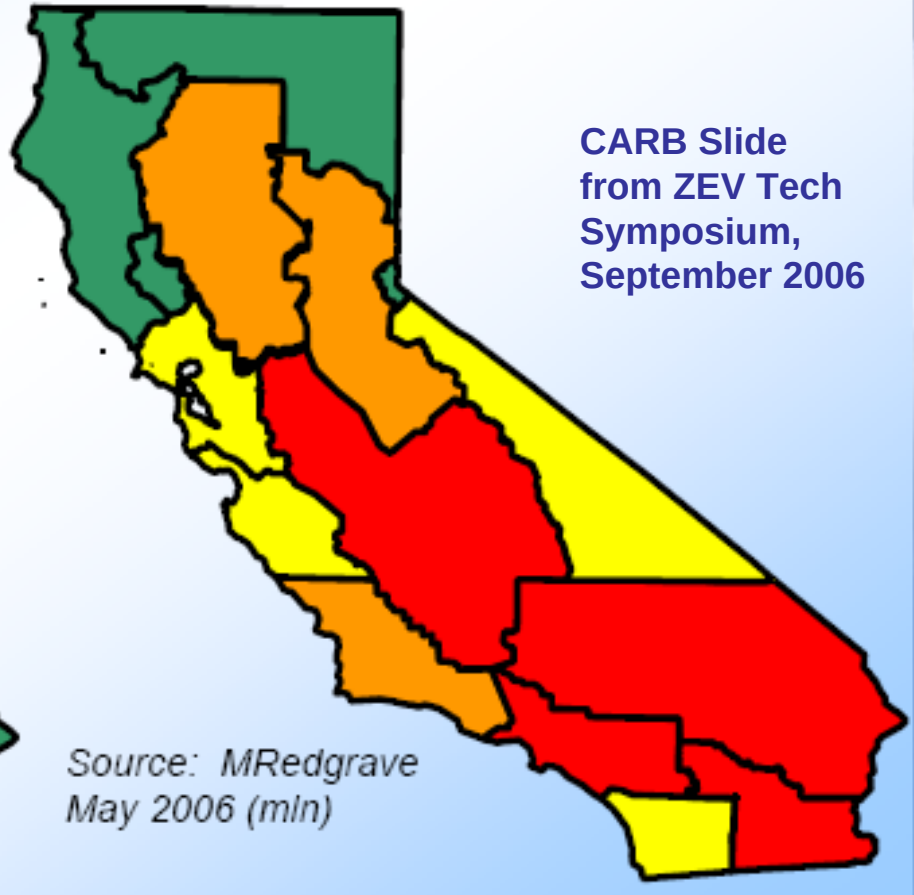
Over 90% of Californians Breathe Unhealthy Air at Times

Days Over State 24-Hour PM10 Standard



Source: ADAM September 2006 (tfn)

Days Over State 8-Hour Ozone Standard



Source: MRedgrave May 2006 (mln)

CARB Slide from ZEV Tech Symposium, September 2006

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

Low Blend Ethanol Emissions Must be Addressed

- Ensure air quality safeguards in place to avoid:
  - NOx increases
  - Permeation VOC emission impacts
    - Must be properly accounted for in state and EPA predictive models
- Off-road impact of low blend ethanol expected to be significant
  - Data still needed for exhaust and evaporative
  - Models need updating
- Low blends decrease CO, but not enough to compensate for VOC increase

Control Low Blend Ethanol in Attainment Areas

- NOx and permeation increases
  - Potential for PM2.5 and climate change concerns?
  - Evap VOC increase from 1.0 RVP increase to conventional gasoline
  - Toxics increase (benzene)
- Boundary to non-attainment areas

Blend without using one pound waiver

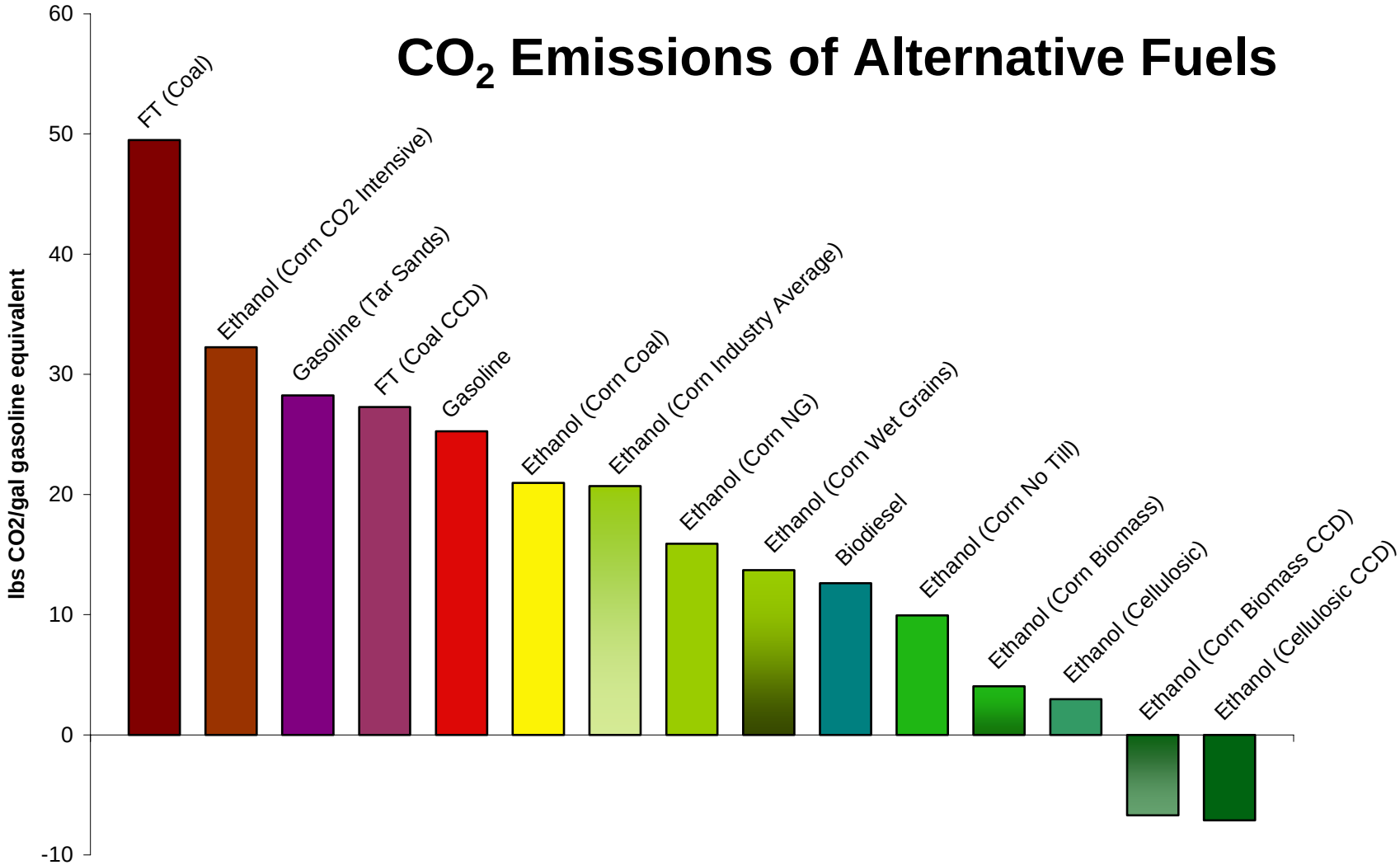
High Blend Ethanol (E85)

- Ultimately could displace more petroleum than low-blend additive approach
- Lower RVP than low blend fuel
- Preliminary FFV permeation data indicates reduction from MTBE fuel
  - FFV (single vehicle test, CRC E-65-3):
    - E0 vs. E10: permeation increased 79%
    - E0 vs. E85: permeation *decreased* 51%
- More FFV testing needed to understand emissions across range of blends (E10 to E85)

E85 Deployment Challenges

- Grow flexible fuel vehicle population (currently over 5 million on US roads)
  - FFV production requirement
- Install infrastructure
  - Incentives such as tax credits
  - Trigger station requirement based on vehicle population
- Price fuel competitively with gasoline
  - Drive development of cellulosic biofuels

Fuel Production Performance Matters



New Production Pathways are Coming

- New technologies
  - Biobutanol, thermochemical processing (gasification), algae feedstocks, and other R&D areas attracting new attention
    - Potential for 15,000 to 200,000 gallons per acre
    - Some could use existing pipeline infrastructure
- To avoid future competition for feedstock, water, land and other impacts, new technologies must provide greater benefits/gallon and more gallons/acre

How To Ensure Sustainable Biofuels Future

- Renewable Fuel Standard (RFS) should set environmental performance standards, including oil displacement/GHG standards
  - Minimum performance standards (e.g., 20% better than gasoline)
  - Market structures that encourage competition based on performance (e.g., RFS credits based on lifecycle GHG emissions)
  - Flexible enough to allow new technologies, fuels, production methods to compete
- Bottom Line: RFS should commit to using more renewable fuels, set performance standards, and shouldn't pick winners prematurely