

# Getting Off Oil: Comparing Two Transportation Strategies

**Fuel Cell Vehicles/Hydrogen Fuel  
vs.  
Hybrid Vehicles/Plug-in Hybrids/Biofuels**

David Morris  
Institute for Local Self-Reliance

Biomass R&D Technical Advisory Committee  
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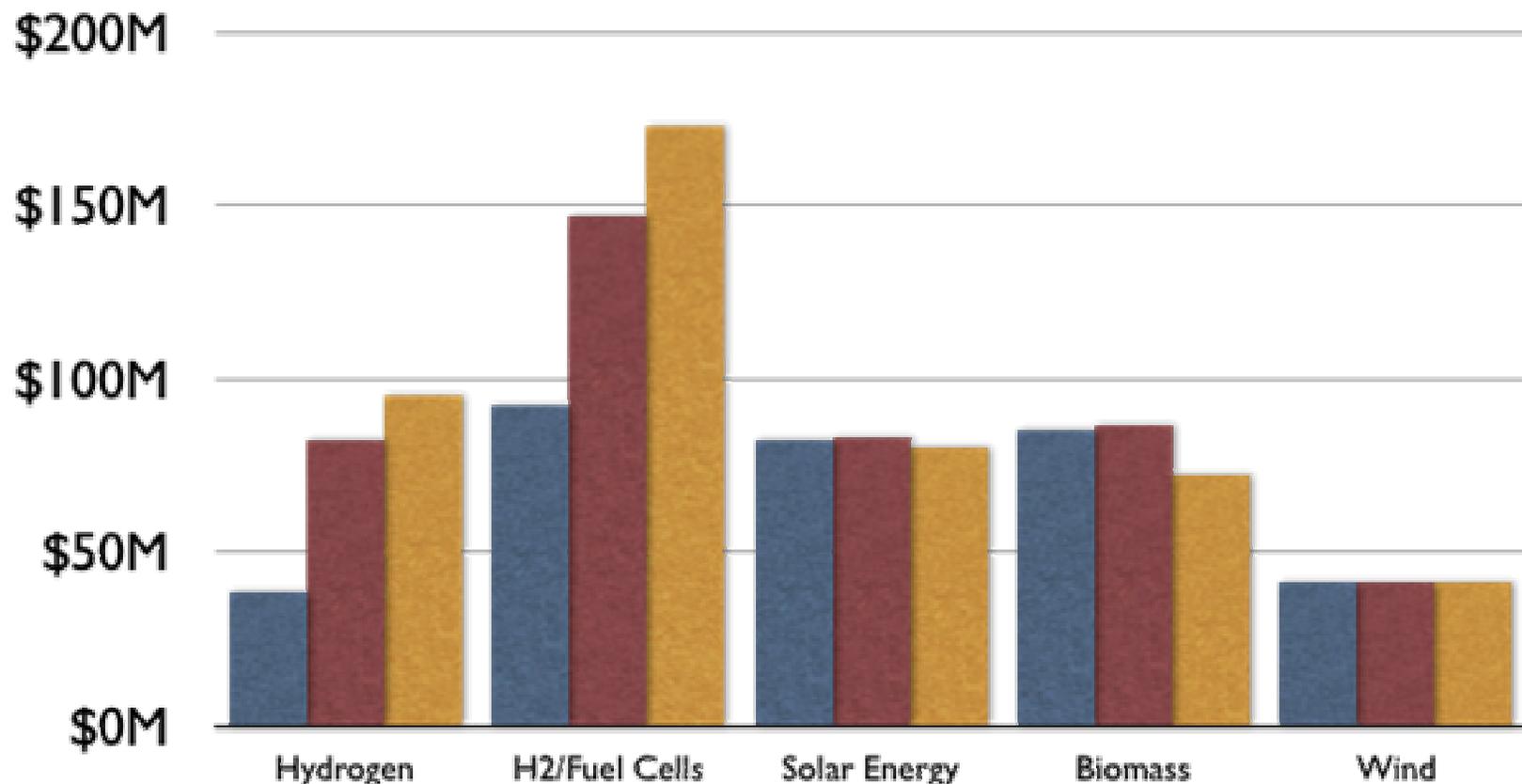
# Why Is This Important?

## DOE Spending

### Hydrogen vs. Renewables

(Excluding Freedom Car)

■ FY2003      ■ FY 2004      ■ FY 2005 Requested



# Comparative Paths to Implementation

- Hydrogen
- H2 ICE
- H2-HEV0,20,60
- H2 FC
- Biofuels
- HEV0/E85
- HEV20/60/E85

# Comparison Measures

- Cost
- Speed of Implementation/Potential
- Environmental Impact

# Comparing Costs

## HEV vs. FCV

Increased Cost Over Conventional Vehicle  
(2004)

HEV0	\$2,000
HEV60	\$7,000
H2 ICE	\$50,000
FC	\$200,000

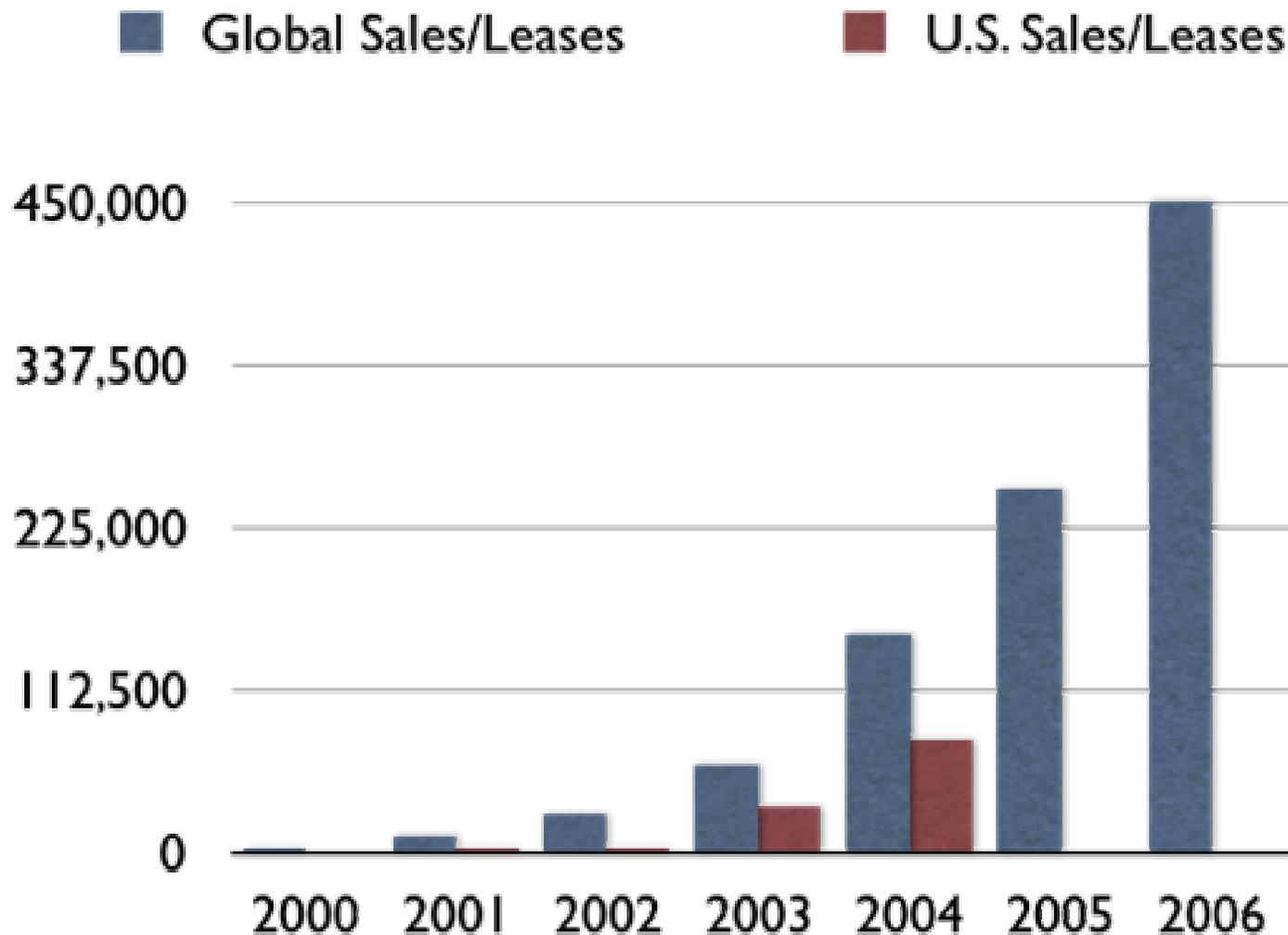
# Comparing Costs

## H2 vs. EtOH

Component	H2	EtOH
Fuel(GGE)/future	\$5/\$2.50	\$1.70-2.15
Vehicle(Incremental Cost/future	\$200k/\$10k(fc)	\$150(ffv)
Fueling Station/ # cars per day	\$500k/10	\$50k/200
Storage/Incremental Cost)	?	\$0

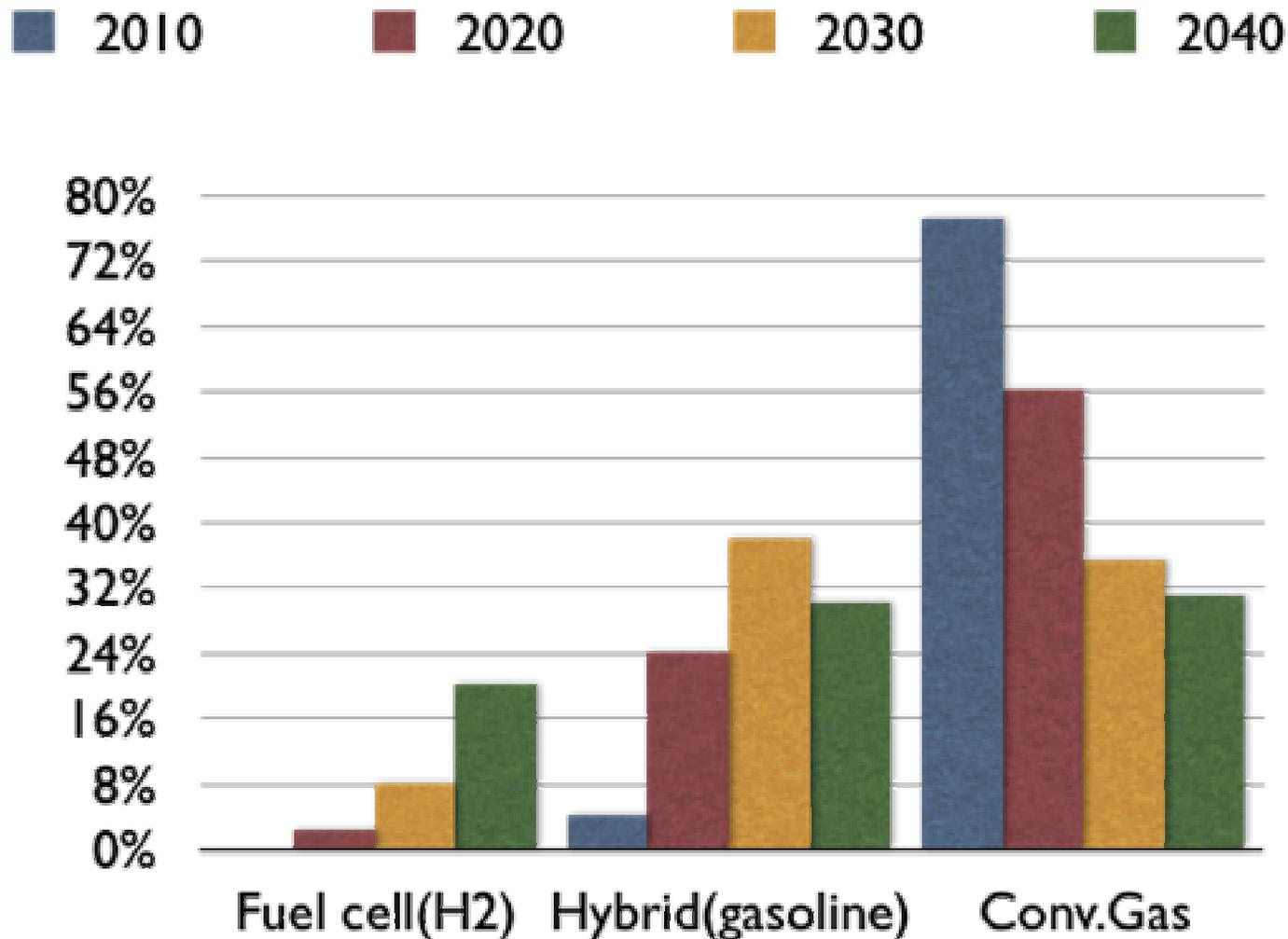
# Comparing Speed of Implementation

## HEV Sales



# Comparing Speed of Implementation

Possible Transportation Future  
(IEA-March 2004)



# Comparing Speed of Implementation

## Market Penetration

California Ethanol 2002-2004	0% to 5.7%
US Hydrogen (projected) 2004-2020	0% to 1%

# Comparing Speed of Implementation-

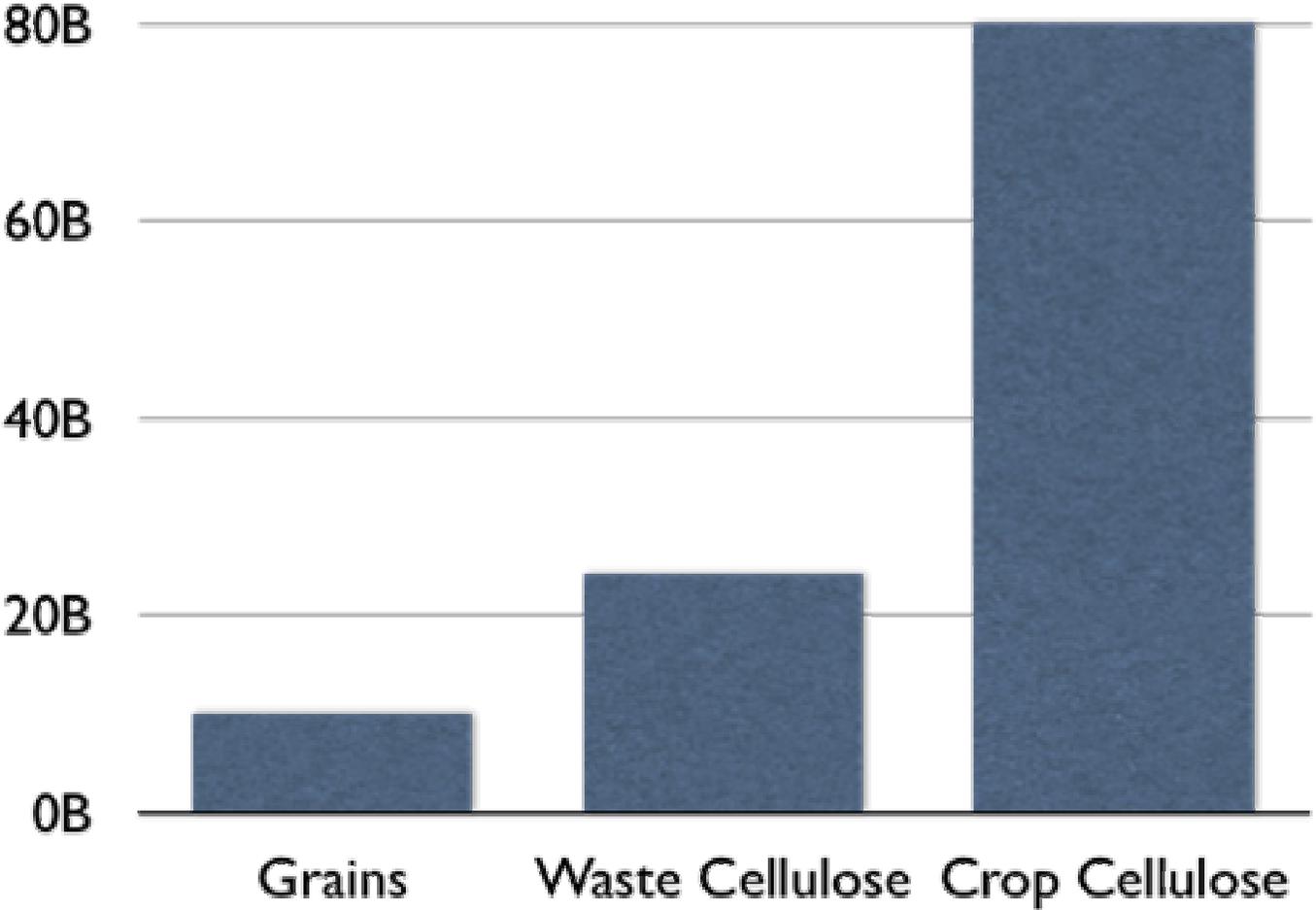
Number of FFV(2004)	4,000,000
Number of FCV(2004)	25
Number of E85 Stations(6/04)	200
Number of H2 Stations(6/04)	20

# Comparing Speed of Implementation

## H<sub>2</sub> and EtOH Production 2004(GGE)

Industrial Hydrogen	40,000,000,000
Fuel Ethanol	8,000,000,000

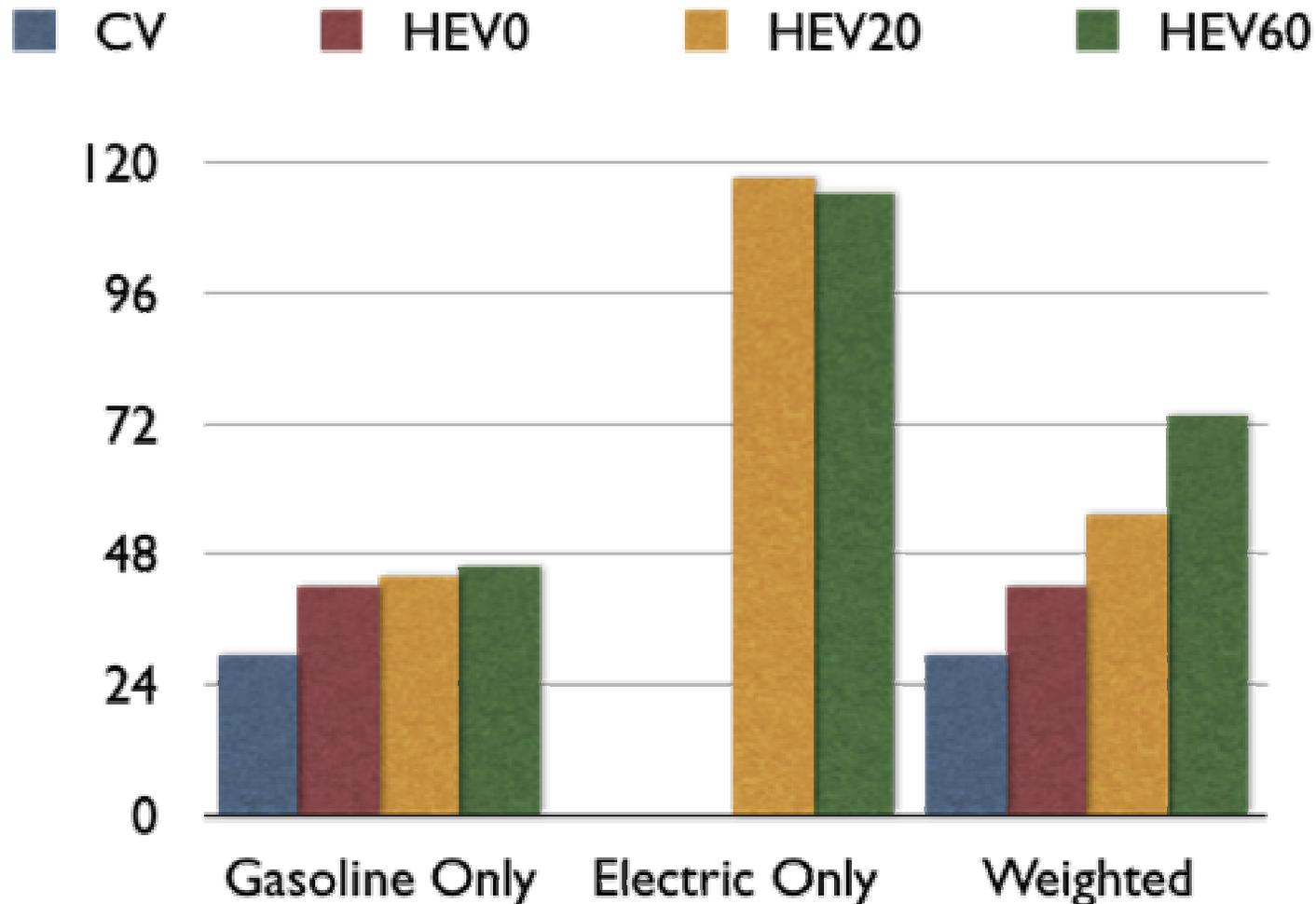
# Ethanol Production Potential (gallons)



# Comparing Environmental Impact

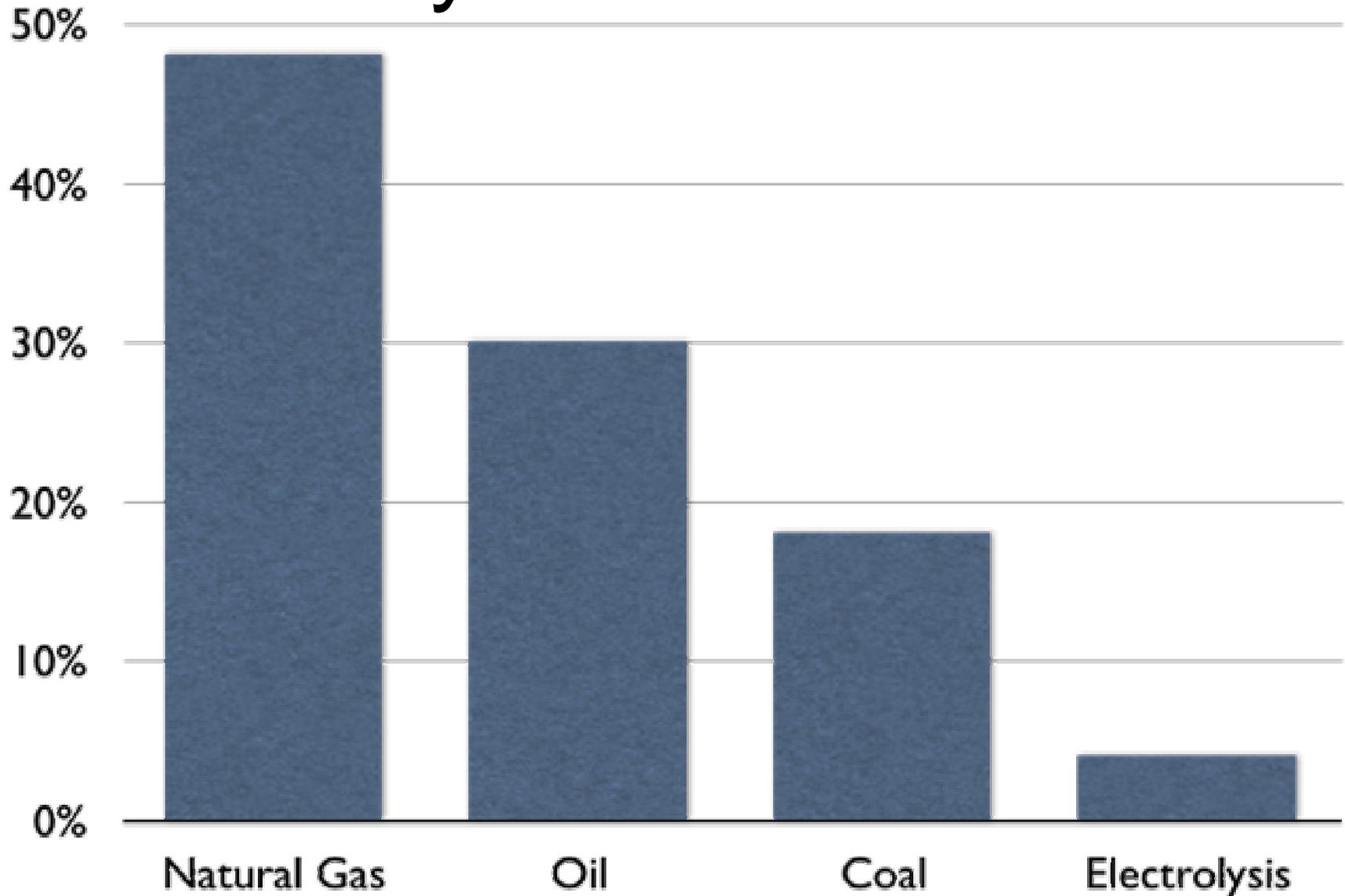
## Fuel Economy

(MPGE)



# Comparing Environmental Impact

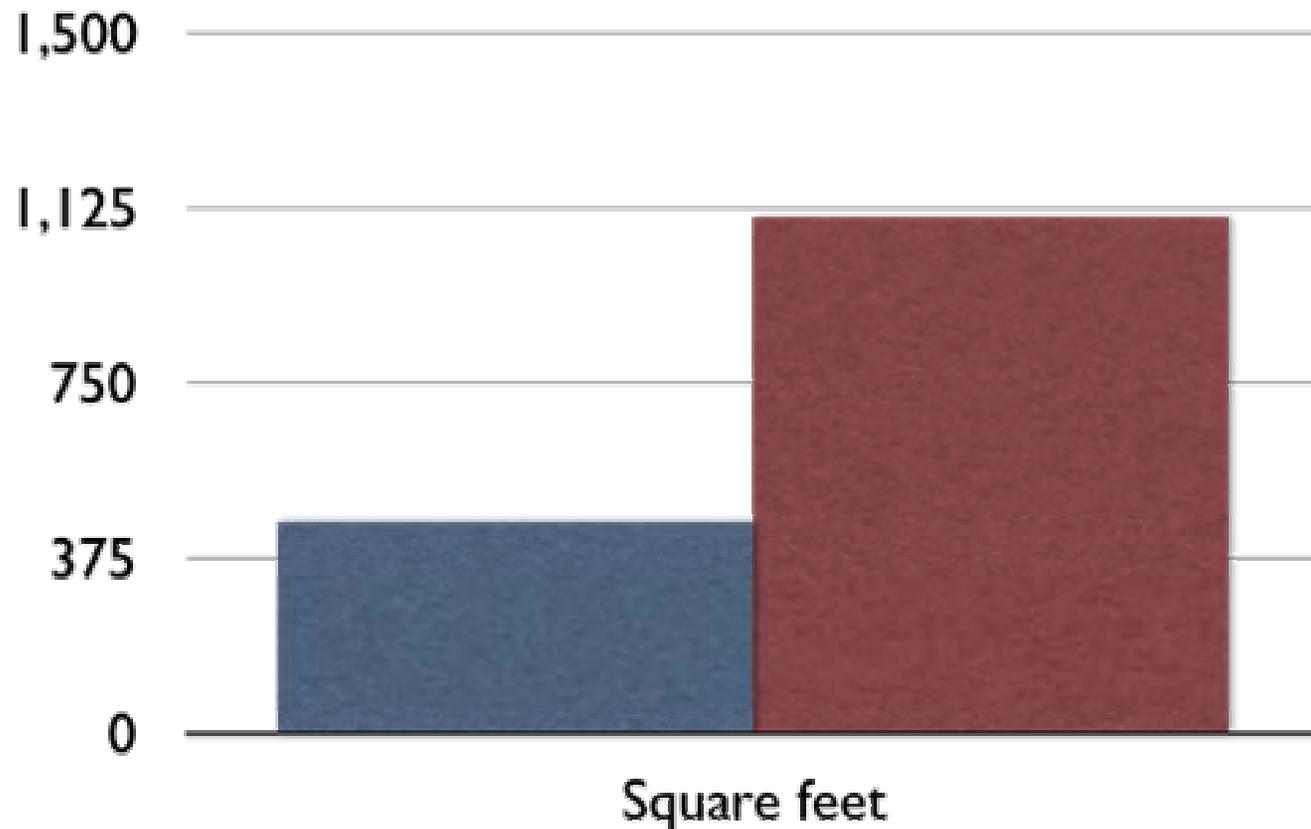
## Worldwide Production of Hydrogen by Feedstock



# Comparing Environmental Impact

## PV Area Needed for Daily Driving Battery Vehicle vs Hydrogen Fuel Cell Vehicle (75 miles per day)

■ Battery EV(.33kWh/mi.)    ■ H2 FC(50 mi./kg)(66 kWh/kg)

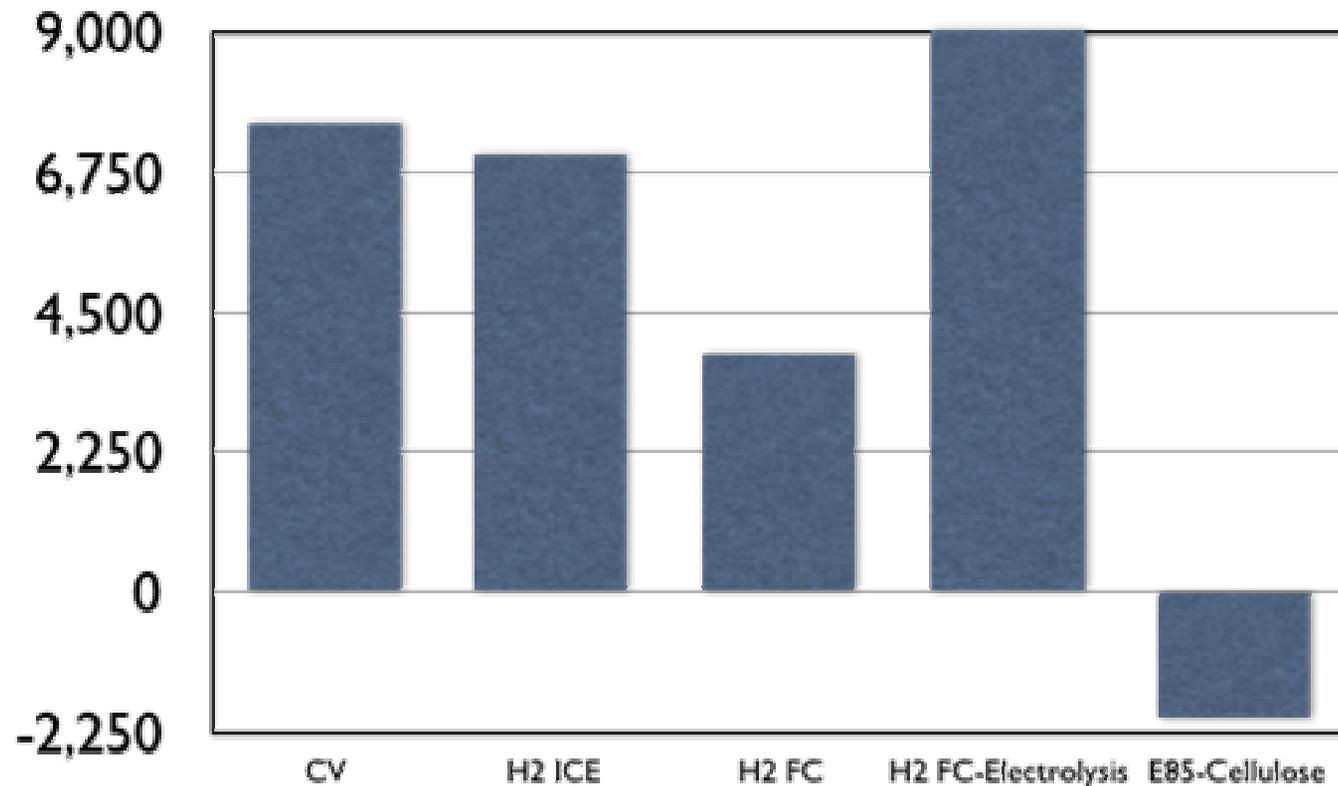


# Comparing Environmental Impact

## Well-to-Wheels Analysis

GHG/vehicle/year

(kg CO<sub>2</sub>-equiv.)



# COMPARING ENVIRONMENTAL IMPACT

## Net Energy Output Hydrogen vs. Ethanol

Ethanol (from grain)	1.57
Hydrogen (from natural gas)	.66