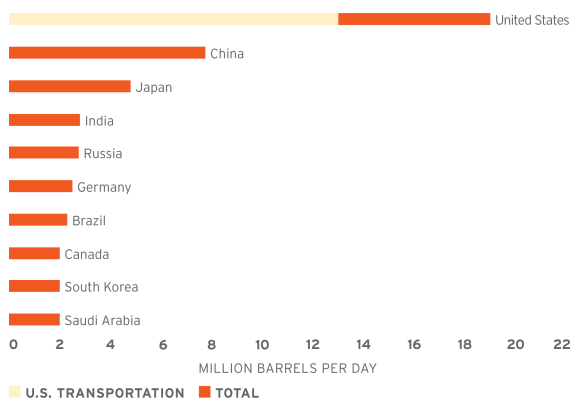


## The Problem

Oil dependence weakens our national security, threatens our economy, and creates environmental challenges.

TOP WORLD OIL CONSUMERS, 2008



› At more than 19 million barrels per day, the U.S. was the world's largest consumer of petroleum in 2008, using about three times as much as China.

› The U.S. transport sector alone consumes more oil than any national economy in the world.

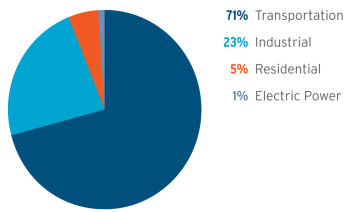
Source: BP, plc

## U.S. Oil Consumption

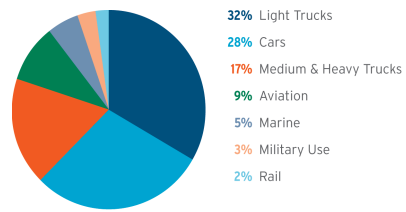
Most of the oil consumed in the U.S. is used in the transportation sector, which is 95 percent reliant on oil-based fuels for energy.

› Approximately 70 percent of U.S. oil consumption occurs in the transportation sector.

OIL DEMAND BY SECTOR (2010 FORECAST)



TRANSPORTATION FUEL DEMAND BY MODE (2007)

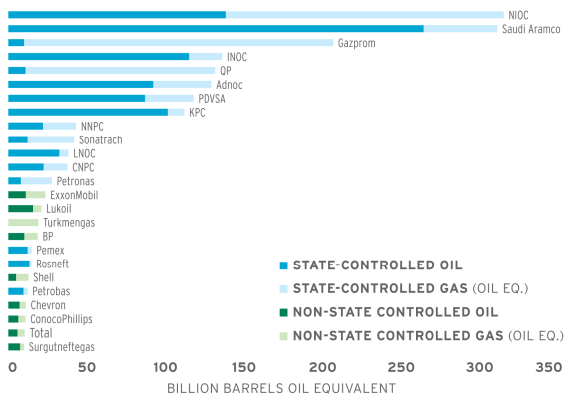


2

## No Free Market for Oil Supply

Oil prices are set in an open market, but that does not mean there is a free market for oil supply.

TOP OIL AND GAS FIRMS BY PROVEN RESERVES\*



- › More than 90 percent of global proved oil reserves are held by national oil companies (NOCs) that are either partially or fully controlled by governments.
- › As a result of this reserve dominance, the world will count on NOCs to provide most of the increase in oil supplies going forward.
- › These companies do set output in the same way as profit maximizing firms in a competitive market.

\*International Energy Agency, World Energy Outlook 2008

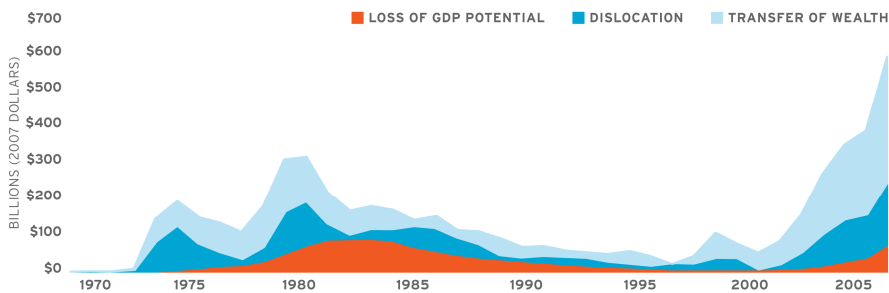
3

## Economic Costs of Oil Dependence

The economic costs of U.S. oil dependence reached \$577 billion in 2008. Since 1970, total economic damage exceeds \$5 trillion (real dollars).

- › In 2008, net U.S. expenditures on crude oil and petroleum products were \$386 billion—56 percent of the total trade deficit.
- › Some costs cannot be quantified with precision, but they remain real costs.
- › Not all costs can be quantified.

### ECONOMIC COSTS OF U.S. OIL DEPENDENCE



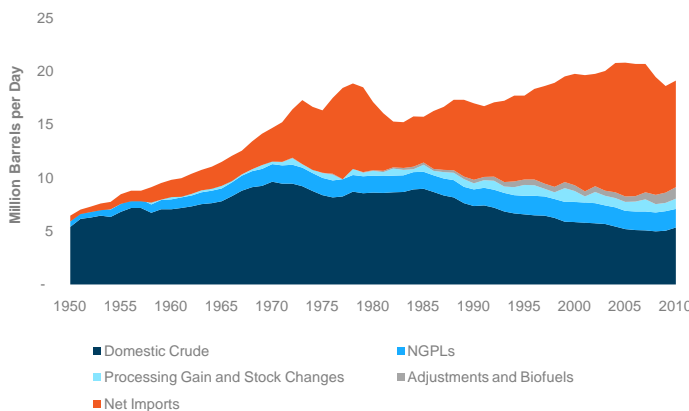
Source: DOE, Office of Energy Efficiency and Renewable Energy

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## U.S. Oil Dependence: Economic Costs

U.S. oil supplies are acquired from a variety of sources, including domestic crude oil and natural gas liquids, biofuels, refinery gains, and imports.

### U.S. OIL CONSUMPTION (HISTORICAL AND FORECAST)



Source: DOE, AER 2009

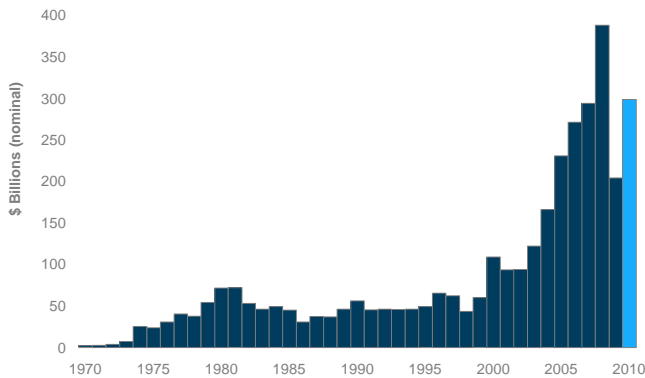
- › Net imports, once a small fraction of U.S. supplies, currently meet more than half of total U.S. liquid fuel demand.
- › Uncertainty exists about future import levels. Current DOE forecasts show imports falling as domestic supplies increase.

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## U.S. Oil Dependence: Economic Costs

In 2008, net U.S. import expenditures on crude oil and petroleum products were \$386 billion—56 percent of the total trade deficit.

U.S. PETROLEUM TRADE DEFICIT (HISTORICAL AND FORECAST)



Source: DOE, AER 2009; May 2010 STEO; SAFE Analysis

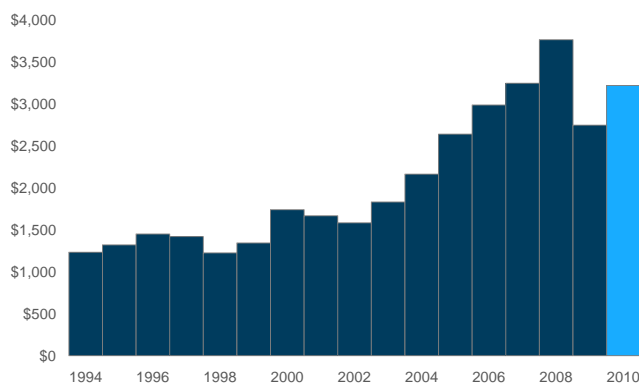
- › Although the recession resulted in a significant reduction in U.S. oil demand and global oil prices, America still ran a \$200 billion trade deficit in petroleum in 2009.
- › With oil prices rebounding and demand stable, the 2010 deficit will likely return to pre-crisis levels.

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## U.S. Oil Dependence: Economic Costs

Household expenditures on gasoline are returning to pre-crisis levels. For the median family, current expenditures represent a significant outlay.

HOUSEHOLD GASOLINE EXPENDITURES (ANNUAL, NOMINAL, ACTUAL AND FORECAST)



Source: DOE, AER 2009; May 2010 STEO; SAFE Analysis

- › In 2009, aggregate U.S. expenditures on refined petroleum products exceeded \$900 billion—or about 6 percent of GDP.
- › The rise in household gasoline expenditures between 2001 and 2008 eclipsed the benefits of the income and estate tax cuts enacted in the same period.
- › In 2008, U.S. median household income was \$50,303. Average household gasoline costs were \$3,770.

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## Economic Costs of Oil Dependence

Rising energy costs likely contributed to recent recession.

› **Cost of Subprime Mortgage Reset**

A typical subprime borrower with a poor credit history who bought a \$200,000 house in 2006 with a 2 year/28 year ARM with a 4 percent teaser interest rate for two years would have seen monthly mortgage payments increase in 2008 from about \$950 to about \$1,330 a month after the reset—an increase of about \$4,500 a year.

› **Rising Household Energy Costs**

Median household energy costs rose by roughly \$1,600 a year during the same two-year period, but affected all U.S. households — not just the one household in 20 that held a subprime mortgage.

› **Rising Household Energy Costs**

In aggregate terms across all households, higher energy costs probably undermined U.S. household financial health more in recent years than resetting subprime mortgages.

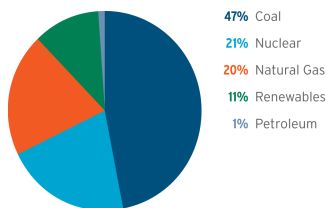
8

## Features of the Electric Power Sector

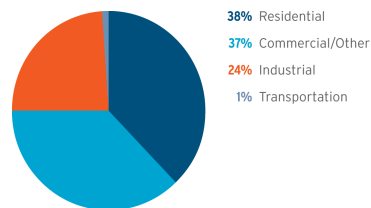
Electrification of transportation is the best solution for dramatically reducing U.S. oil dependence.

- › Electricity is generated from a diverse portfolio of domestic fuels
- › Electricity prices are stable
- › The power sector has substantial spare capacity
- › The network of infrastructure already exists

**U.S. ELECTRICITY GENERATION BY FUEL (2010 FORECAST)**



**U.S. ELECTRICITY DEMAND BY SECTOR (2010 FORECAST)**

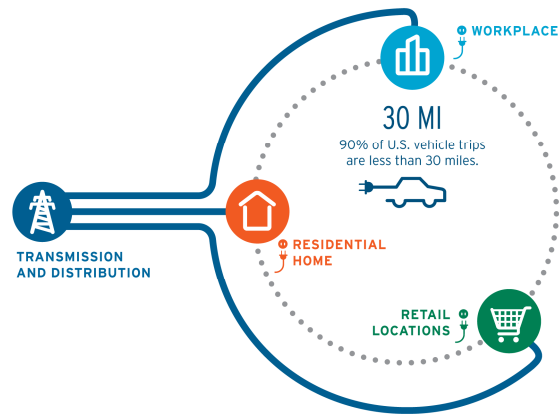


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## Electrification of Transportation

The transportation system and the electric power sector are completely separate. GEVs can synergize these two systems for the first time.

### ELECTRIFICATION ARCHITECTURE

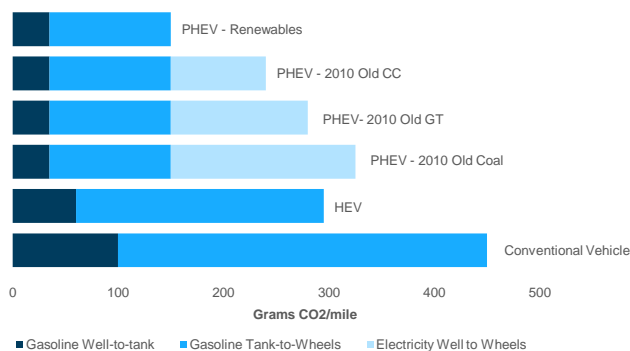


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## Electric Power Sector: Emissions

Depending on the source of power, grid-enabled vehicles will offer varying levels of emissions improvement compared to an IC engine vehicle.

### VEHICLE EMISSIONS BY TECHNOLOGY AND FUEL



Source: EPRI, NRDC

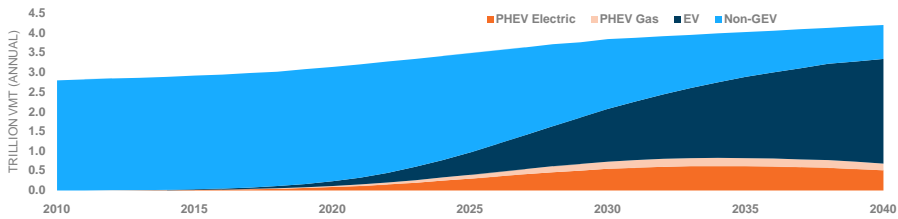
- › The key variable determining the power source for GEVs will generally be the low cost source of off peak generating capacity.
- › Natural gas will meet as much as 60 percent of incremental GEV demand, depending on the time and strength of charge (ORNL).
- › Even when fueled by electricity generated by a conventional coal plant, GEVs are cleaner than IC engine vehicles.

11

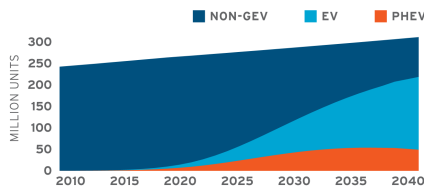
## The Goal:

By 2040, 75% of the vehicle miles traveled in the U.S. should be electric miles.

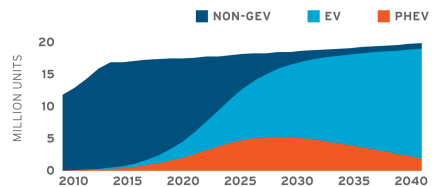
### TARGETED LIGHT-DUTY VEHICLE OIL ABATEMENT



### REQUIRED GEV FLEET PENETRATION



### REQUIRED GEV SALES



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## Electrification Overview: Challenges

While electrification has promise as an energy strategy, it can only succeed if GEVs are attractive to the mass market and can integrate into the grid.

### › Batteries and Vehicles

With the advent of lithium-ion battery technology, the largest obstacle to widespread consumer adoption of these vehicles will be cost, though performance and raw material supply chains are also important to consider. Market needs to identify innovative business models, scale in Gen-1/2, and R&D for Gen-3.

### › Charging Infrastructure

A profitable business model for public charging points has not been reliably demonstrated, and we do not yet know how much public charging will be needed.

### › Electric Power Sector Interface

While “smart” charging will make electric vehicles an asset to the grid, “dumb” charging will make them a liability.

### › Consumer Acceptance

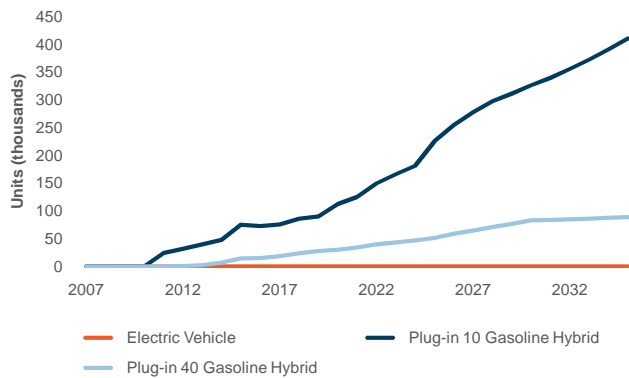
GEVs represent a significant shift in technology. In order to change mainstream consumer attitudes, GEVs must offer a compelling alternative to conventional IC engines on either cost or performance grounds.

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## Baseline Forecasts from DOE

Department of Energy forecasts for vehicle technology sales place EVs and PHEVs on a limited deployment curve over the next 25 years.

LIGHT-DUTY GRID-ENABLED VEHICLES: ANNUAL SALES



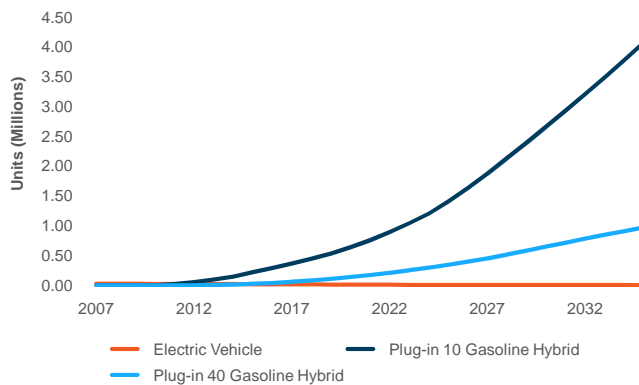
- › Annual light-duty vehicle sales average between 16 and 19 million units throughout the forecast period.
- › GEVs account for a small percentage of annual sales, reaching just 2.6 percent in 2035.

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## Baseline Forecasts from DOE

Department of Energy forecasts for vehicle technology sales place EVs and PHEVs on a limited deployment curve over the next 25 years.

LIGHT-DUTY GRID-ENABLED VEHICLES: FLEET PENETRATION



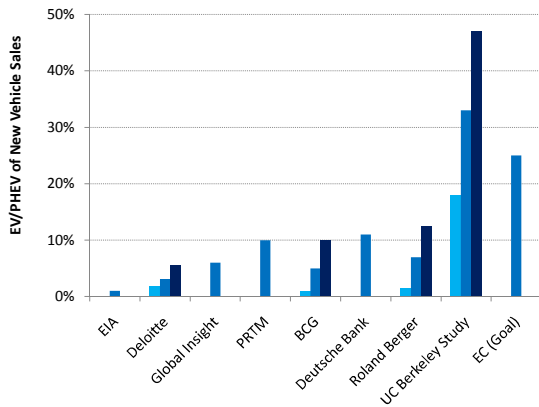
- › In 2020, DOE estimates GEV stock of less than 800,000 vehicles—less than 1 percent of the LDV fleet.
- › By 2035, the U.S. light-duty vehicle fleet is expected to reach nearly 300 million cars and SUVs. GEVs reach just 1.6 percent of the fleet in DOE's baseline forecasts.

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## Forecast GEV Market Penetration Rates

Looking out to 2020, there is a wide range of EV/PHEV market growth forecasts.

### Comparison of 2020 Global EV/PHEV Sales Forecasts



*Key Forecast Differences Emanate from Differences in:*

- Component cost reductions (primary difference)
- Energy cost forecasts
- Future environmental policy
- Consumer acceptance

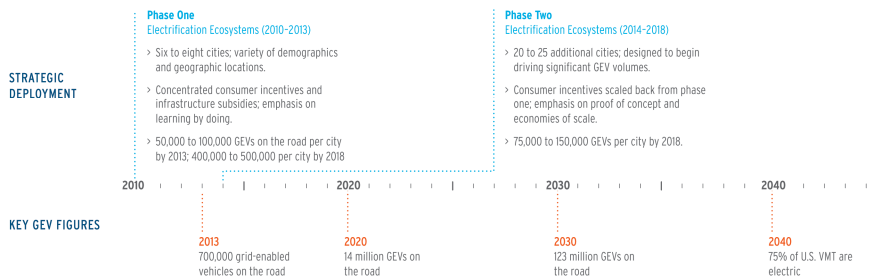
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## Roadmap to Electrification: Ecosystems

To overcome these challenges, lawmakers should initiate an ambitious program to support GEV networks: Electrification Ecosystems.

- › Move beyond early adopters
- › Prove that wide scale deployment of GEVs is not only possible, but desirable
- › Take advantage of economies of scale
- › Support research to answer critical questions about vehicle usage and recharging patterns

### PHASED DEPLOYMENT



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## Roadmap to Electrification: Ecosystems

To overcome these challenges, lawmakers should initiate an ambitious program to support deployment into a limited number of communities.

### FEATURES AND ADVANTAGES OF DEPLOYMENT COMMUNITY APPROACH

- › A deployment community approach would initially concentrate amplified financial incentives for consumers, infrastructure providers and utilities into a limited number of regions. The number of communities would expand over time in two phases.
- › Regions would be selected on a competitive basis. The most attractive regional bids would demonstrate a clear path to successful integration of GEVs, including:
  - › A supportive regulatory environment that facilitates concepts like utility investment in upgraded physical and IT assets; time-of-use pricing; and a seamless process for permitting and installing level II EVSEs in residential consumer garages.
  - › Support and participation from a broad swath of stakeholders, including state and local governments, utilities, utility regulators, large local employers, universities and others.
- › In sum, successful bids should be those in which all pieces have been brought together—autos, infrastructure, favorable regulatory environment, interested consumers—to ensure that large-scale deployment of GEVs has the best chance of success.

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## Roadmap to Electrification: Ecosystems

To overcome these challenges, lawmakers should initiate an ambitious program to support deployment into a limited number of communities.

### FEATURES AND ADVANTAGES OF DEPLOYMENT COMMUNITY APPROACH

- › Focusing on targeted regional deployment accomplishes at least three objectives:
  1. **Demonstrate Proof of Concept for Consumers:** When the infrastructure, regulatory environment, and community commitment are coordinated, GEVs:
    - › offer superior performance with lower operating costs;
    - › can be charged easily and reliably; and,
    - › meet most drivers' regular transportation needs.
  2. **Facilitate Learning by Doing** by helping the industry better understand what business and regulatory models and infrastructure are necessary to support robust deployment of GEVs.
  3. **Maximize Investment Payoff** by taking advantage of economies of scale.
- › The deployment community approach recognizes that a widespread national rollout without careful planning will reduce the likelihood that GEVs can penetrate the mass market, instead being relegated to niche market status (as has happened with hybrid vehicles, 1.6 million of which have been sold over the past 11 years out of a light-duty fleet of 250 million vehicles).

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## Additional Recommendations to Promote Economic Growth and Electrification

- › Establish a guaranteed residual value for used large format automotive batteries
- › Establish tax credits for installing automotive grade batteries in stationary applications to help drive scale
- › Establish loan guarantees for retooling automotive assembly lines
- › Modify building codes to promote GEV adoption
- › Promote the inclusion of GEV-related investment in the utility rate base
- › Adjust utility rate structures to facilitate GEV deployment
- › Review existing regulations on vehicle warranties

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Electrification  
Coalition

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