The “Big 5” – Issues facing the auto industry

- Growth of global industry & technology in the 20th century
- Rapid increase in fossil fuel consumption
- Population growth and the growing numbers of vehicles
- 1. Energy & Fuel Diversification
- 2. CO₂ Reduction
- 3. Air Quality
- 4. Urban Congestion
Concept of Energy Source Utilization

Electricity and hydrogen as energy carrier have various primary sources:

- Biomass
- Solar / Wind
- Water / Nuclear
- Petroleum
- Natural gas
- Coal
- Petroleum
- Natural gas
- Coal
- Solar / Wind
- Water / Nuclear

Changes in CO₂ Concentration

Atmospheric CO₂ concentration has dramatically increased since the middle of 20th century.
World CO₂ Emissions

CO₂ reductions are expected — reduction arising from vehicles has considerable contribution.

Well-to-Wheel CO₂ Emission

FCHV (Hydrogen) has high potential of low CO₂ emission at WTW comparison.
HVVs can contribute to reducing CO2 emissions. Technology to save the use of precious petroleum
Air Flow Management

Coefficient of Drag = .25
Less air resistance = reduced energy consumption

Hybrid Synergy Drive®

Motor/Generator 1

Previous
New

30% Hybrid System
Weight Reduction

Motor/Generator 2

Previous
New
There is a strong correlation between Prius sales and gasoline prices in the U.S.

Utilization of Electricity: Plug-in Hybrid Vehicle (PHV)

Expanding the electric-motor-only cruising range through recharging battery using an external power source.

At this time, PHV is the most viable option to utilize electricity.
Plug-In hybrid vehicle initiatives

• Future vision of PHEV:
  - Recharging circuit
  - Engine
  - Battery
  - Regenerative braking (energy recovery)
  - Cellulosic ethanol (waste materials)
  - (carbon neutral energy)
  - Photovoltaic generation

Challenges remaining:
Battery cost / life, emissions from grid, emissions from fuel choice, all-electric range, etc…

CO₂ Emissions

When electricity is generated from low-carbon sources, the CO₂ emissions of a PHV are lower than an HV

The advantage is big in France where nuclear power generation is common. There is no advantage in China, which mainly uses coal-fired power plants.
Cost of Technology
Consumption vs. Fuel Economy

![Graph showing annual fuel savings from increasing FE by 10 mpg.]

Consumption - Gallons/Year
Fuel Economy - MPG

Toyota e-com
shared-use ‘community’ EVs
for employees

Crayon System
pay-as-you-go public EV
rentals

Last Century Urban Mobility Projects
Urban Mobility Projects Today → EV

Toyota’s idea of a city electric vehicle. Short range; dual voltage charging; high degree of connected IT.

Major Technical Challenges for FC Vehicles

A. Cruising range
B. Freeze start capability
C. Stack durability
D. Cost, Compactness & High Power Density
- TOYOTA FCHV-adv has achieved an actual cruising range of over 500 km.
- FC system efficiency has also substantially improved up to 64%.

The cold-weather performance tests verified that the cold start and driving performance of the TOYOTA FCHV-adv was equivalent to that of gasoline-powered vehicles.
Goal of Cost Reduction for FCHV

In the near term, we aim to reduce the cost to 1/10 of the current level by innovations in design, materials, and production technology.

Pathway to Sustainable Mobility

Ultimate eco-car

Hybrid Technology

Right car • Right place • Right time

Synthetic fuel Biofuel Diesel Gasoline Electricity Hydrogen

EV: Electric vehicle THS: Toyota Hybrid System HV: Hybrid vehicle FCHV: Fuel cell hybrid vehicle
Thank you