

# Zero Emissions Vehicles Technology Symposium

Independent Expert Panel

Status Report

Michael P. Walsh, Chairman

Dr. Fritz Kalhammer

Bruce Kopf

Dr. Vernon Roan

Dr. David Swan

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# Objectives of the Panel

- Provide an Assessment of the Technical and Cost Status and Prospects of the Main Technologies Currently Under Development for Zero Emissions Vehicles (ZEVs) and Near ZEVs, including
  - Battery Electric Vehicles (BEV)
  - Fuel Cell Vehicles (FCEV)
  - Hybrid Vehicles (HEV)
  - Plug In Hybrid Vehicles (PHEV)
  - Hydrogen Combustion Engine Vehicles (H2ICE)



# Scope of Study (Investigation)

- Tasks To Be Carried Out
  - Acquisition of Information
  - Critical Assessment of Information
  - Presentation to the ARB
  - Prepare a Final Report
- Information Sources
  - North America, Japan, Europe, Korea
  - Major Automobile Manufacturers
  - Leading Developers of ZEV-Enabling Technologies
  - Leading Organizations Engaged in ZEV Technology R&D (DoE, National Labs, etc.)



# Major Effort To Date Has Been The Acquisition of Information

- Questionnaires in the Following Technology Areas Have Been Prepared and Distributed To Many Individuals and Organizations
  - Vehicle Energy Storage Systems (Batteries)
  - Vehicle Hydrogen Storage Systems
  - Vehicle Fuel Cell Systems – Stack and Associated Components
  - Vehicle Integration of Advanced Technologies
- Meetings Have Been Carried Out or Planned With:
  - Major Vehicle\* Manufacturers with Significant Sales in California
  - Major Suppliers of Critical ZEV Related Components Around the World
- Meetings Should Be Completed By the End of October

\* In Some Cases Multiple Meetings Have Taken Place

# Acquisition of Information (2)

- Follow Up Questions have been Submitted to Many of the Companies/Organizations With Which We Have Met
- Questionnaires Have Also Been Sent to Many of the Organizations involved in the DoE Advanced Technology Programs

The Meetings with the Vehicle Manufacturers and Others Have Generally Been Very Productive and Much New Information Has Been Shared With Us So Far



# Critical Assessment

- With the Information Already Received and Gradually Arriving, this Has Now Begun
- This Will Be The Major Focus Over The Next Two Months
- A Working Outline of Our Report Has Been Prepared and We Are Beginning To Draft Sections At This Time



# Panel Members and Points of Focus

	Team Chair	ZEV Technology Vehicle Integration	Fuel Cell Stack & Components	On Vehicle Hydrogen Storage	Energy Batteries	Other Topics
Michael Walsh	X					
Vernon Roan			X	Subgroup Lead		X
Fritz Kalhammer					Subgroup Lead	X
Bruce Kopf		Subgroup Lead	X	X		X
David Swan			Subgroup Lead	X	X	X

# Vehicle Energy Storage Systems

## Dr. Fritz Kalhammer

- Scope

- Timeframe: technology fully developed in this decade
- Battery manufacturers/developers (“worldwide”)
- Batteries with potential for EVs and PHEVs (HEVs)
- Focus: NiMH and Li Ion (ZEBRA; Li-Sulfur)

- Issues

- Key battery technology issues and study focus: cost, life, safety (Li Ion), and energy density (for EVs)
- Main challenge for the study: obtaining good data for battery cost, calendar life (for Li Ion batteries)



# Vehicle Hydrogen Storage Systems

## Dr. Vernon Roan

- Scope
  - • **Candidate Technologies**
    - Compressed Hydrogen Gas Storage
    - Liquid Hydrogen Storage
    - Hydrogen Storage in Solids
    - Hydrogen Stored in Liquids
- Issues
  - • **System Requirements**
    - DOE Targets
    - Input from Industry and other Sources
  - • **Current Status of Technologies**
  - • **Outlook for Selected Technologies**



# Vehicle Fuel Cell System

## Dr. David Swan

- Scope
  - Fuel cell systems for propulsion and auxiliary power
  - Consider complete system (hydrogen to net electricity)
- Issues
  - Performance Goals
    - Net efficiency and system specific power
    - Vehicle packaging and NHV
    - Operational characteristics (start up, response time, etc.)
  - Life
    - Durability of fuel cell system for life of chassis
    - Operation and storage in cold or hot ambient conditions
    - Air and fuel purity
  - Cost
    - Basic materials for electrode membrane assemblies
    - Fuel cell stack components and construction
    - Balance of plant complexity (fuel cell support systems)
  - Time frame to reach technical viability for commercialization

# ZEV Technology Vehicle Integration

## Bruce Kopf

- Scope
  - Two ZEV technologies – BEV and FCEV
  - Five closely associated advanced technologies – NEV, HEV, PHEV, H2ICV, APU
- Input:
  - 10 major manufacturers representing 98% share of US market
  - Others – Electricity de France, Miles Automotive (scheduled), etc.
- Issues
  - BEVs
    - Cost competitiveness of technology (assuming high volume manufacturing)
    - Meeting customer requirements
    - Likely potential timing for volume production (e.g. 100s, 1000s, etc.)
  - FCEVs
    - Cost competitiveness of technology (assuming high volume manufacturing)
    - Meeting customer requirements
    - Availability of Hydrogen infrastructure
    - Likely potential timing for volume production (e.g. 100s, 1000s, etc.)
  - Other Advanced Technologies



# Next Steps

- Continue with Meetings and Visits
  - Some Meetings With Symposium Participants this Week
  - Some Have Already Been Interviewed, Some Are Scheduled and Others Will Soon be Scheduled
- Panel Meetings With Continued Assessments and Planning
- Identify Additional Information Needs, Continue Drafting As Appropriate For The Final Report

