California Fuel Cell Partnership

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H2USA GENERAL MOTORS

Cooperation & Coordination

H_2USA

Public – Private Collaboration

Focused on facilitating roll-out of supporting infrastructure

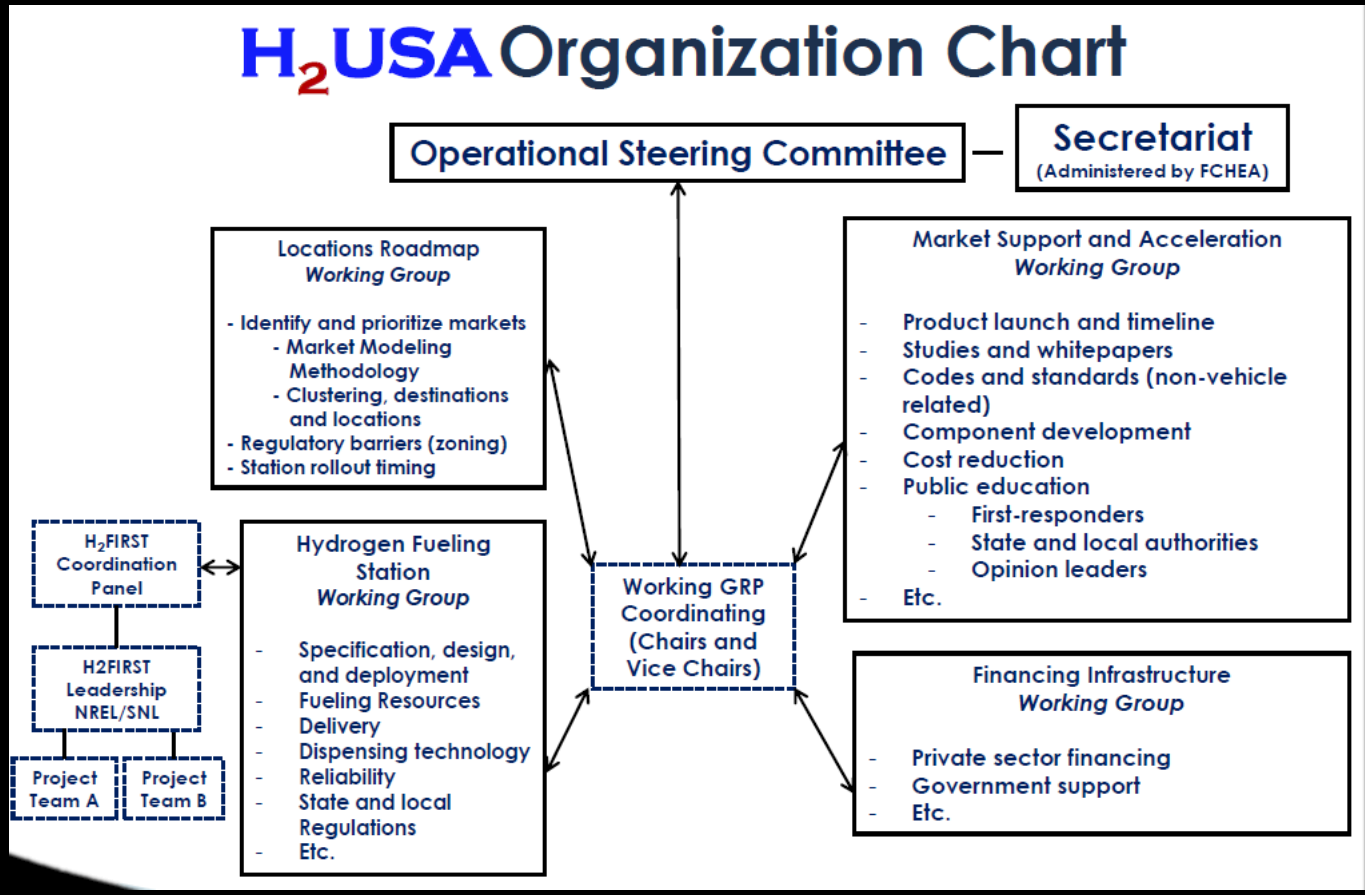
- High-level Goals:
  - Establish Necessary H_2 Infrastructure
  - Leverage Multiple Energy Sources
    - Including natural gas & renewables
  - Support FCEV Deployment within USA
- Expected Benefits:
  - Improve US Energy & Economic Security
  - Develop Domestic Resources & Create US Jobs
  - Validate New Technologies
  - Strong Clean Energy Domestic Supply Base
  - Substantially Reduced Greenhouse Gas Emissions

Cooperation & Coordination

H_2USA

Coordinated by Operational Steering Committee

- Four Primary Working Groups
  - Locations Roadmap
    - Identify & Prioritize Infrastructure Market Opportunities
    - Address Regulatory Roadblocks (zoning)
    - Define Timing Requirements
  - Hydrogen Fuel Station
    - Coordination with H_2FIRST
    - Address Requirements for Dispensing Technologies
  - Financing Infrastructure
    - Establish Financing Business Models
  - Market Support & Acceleration
    - Define Product Launch Timelines
    - Conduct Studies to Address Requirements
    - Coordinate non-vehicle Codes & Standards
    - Support Public Education



U.S. Infrastructure

Concentration in Two Regions (California & Northe

Guiding H_2 Infrastructure Deployment

Key Questions to Consider

- What Propulsion System is Required?
- Why Fuel Cells?
- Why Hydrogen?
- Why is it Taking So Long?
- Why Can’t I Have a Station Too?
- How can this be Achieved?
- Roles for Collaboration, H2USA

Successful Infrastructure Roll-Out & Collaboration Must Comprehend Above

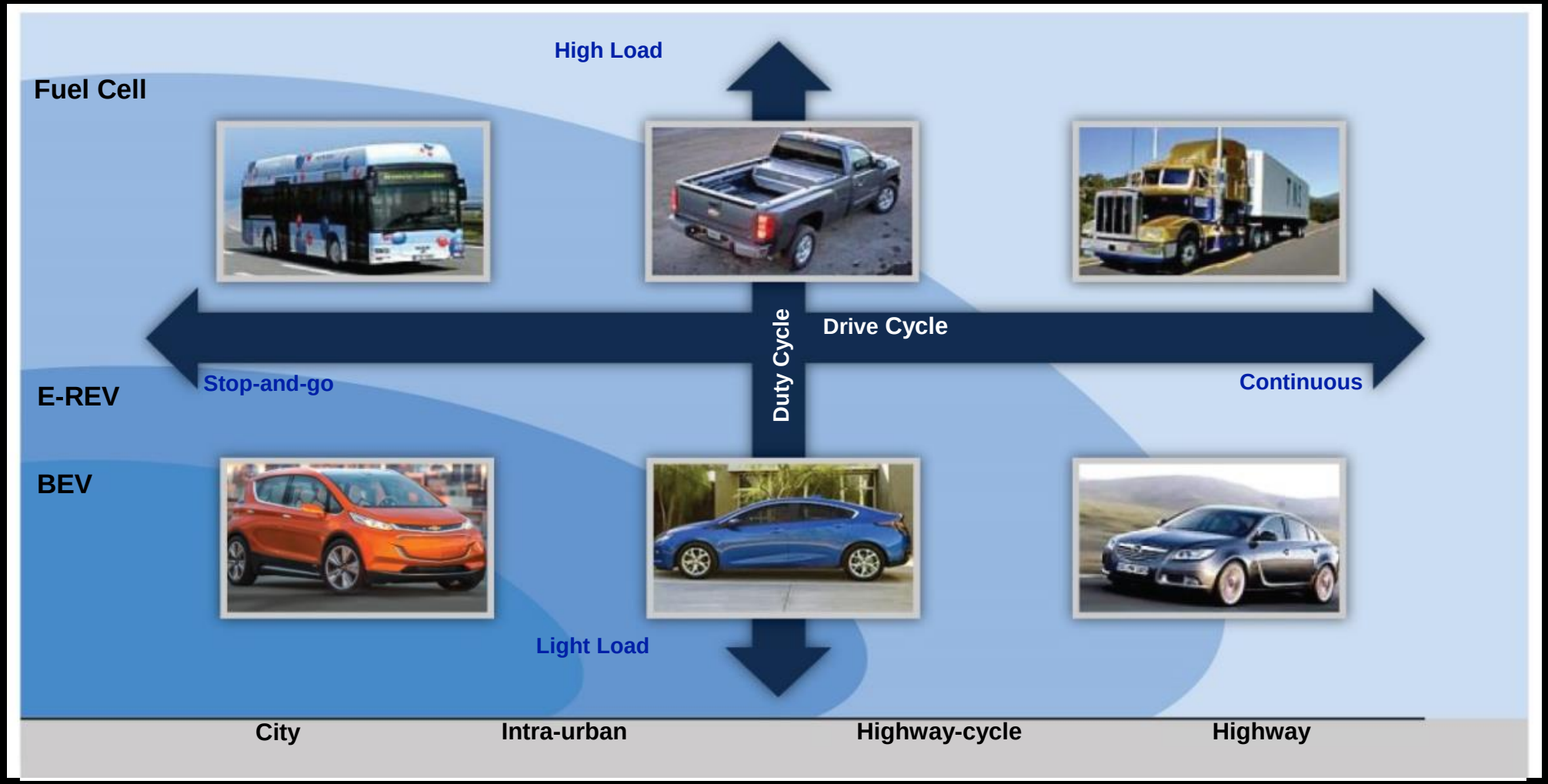
Guiding H_2 Infrastructure Deployment

- What Propulsion System is Required? – Require BOTH Batteries AND Fuel Cells
- Why Fuel Cells? – The Fast Charging Electric Vehicle
  - Better Solution for Specific Customers Requirements
  - Unique Capability & Scalable
- Why Hydrogen? – The Universal Energy Translator
  - Energy Carrier
  - Energy Storage Mechanism
- Why is it Taking So Long? – Progress is Substantial
  - We are only beginning
  - Always Challenging to Manage Expectations
- Why Can't I Have a Station Too? – Be Careful what you ask for
  - Diluting concentrated station deployment strategy adds risk
- How can this be Achieved? – Sustainable Incremental Solutions
  - New Business Models Required
  - Cross-Industry, Public-Private Collaboration Required (Energy & Utility Sectors) – Broad Stakeholders
- Roles for Collaboration

Successful Infrastructure Roll-Out Must Comprehend Above

Technology Application Map

Where do Hydrogen Fuel Cells Fit?



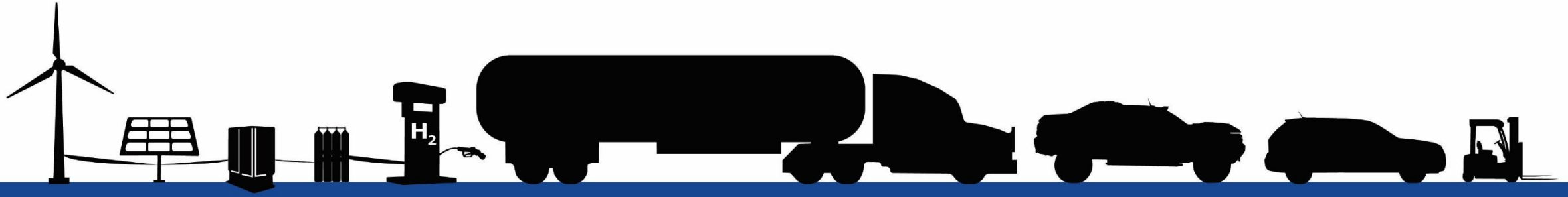
No Single Technology Solves Portfolio Needs Alone

Battery & Fuel Cell Technology - Both have roles to play within Propulsion Portfolio

Broad Opportunities for Hydrogen

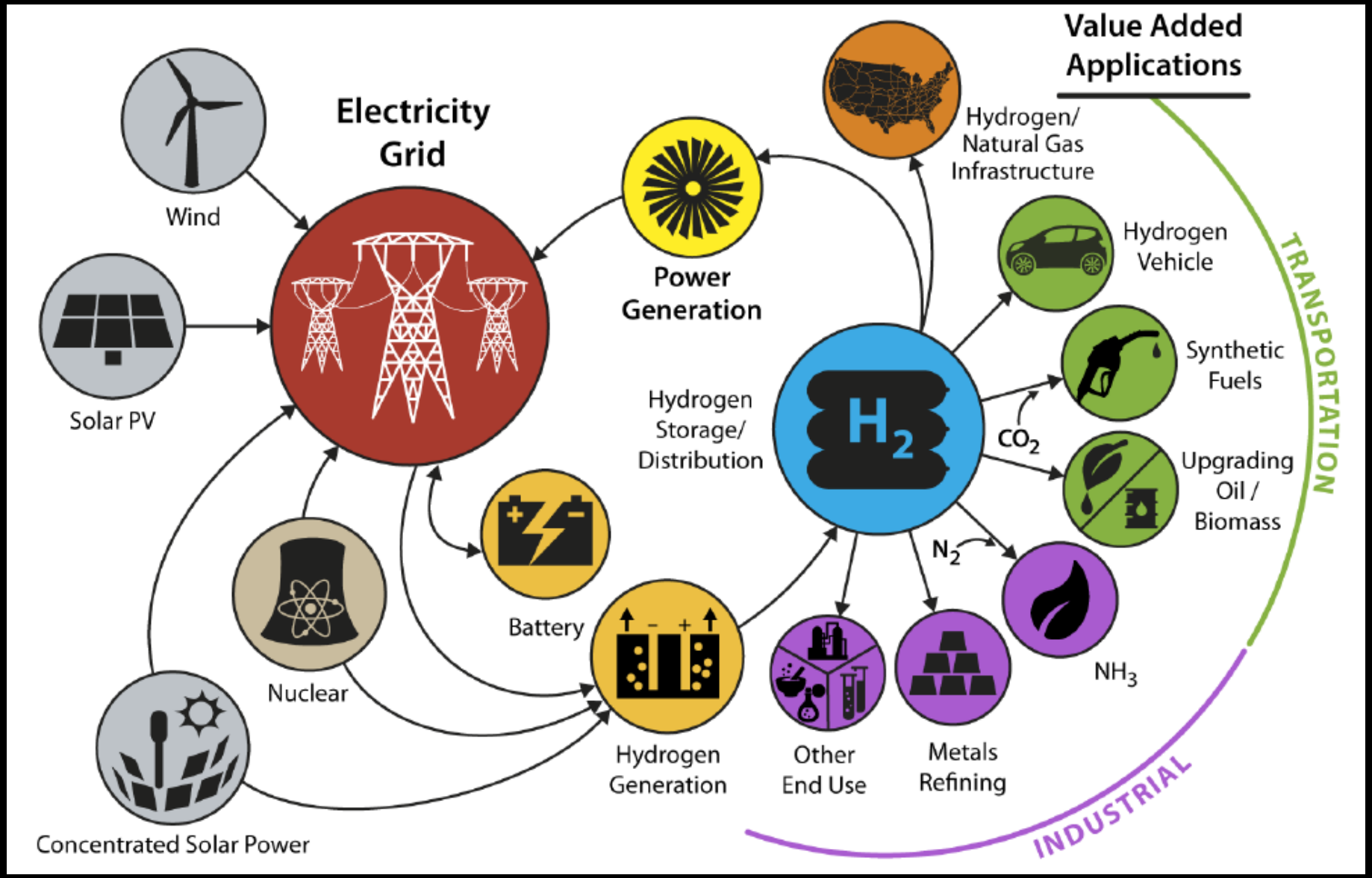
AUTONOMOUS AERIAL VEHICLES • AIRCRAFT SYSTEMS • AIRCRAFT GROUND SUPPORT EQUIPMENT

ELECTRIC VEHICLES • STATIONARY POWER • MICROGRID • ROBOTICS



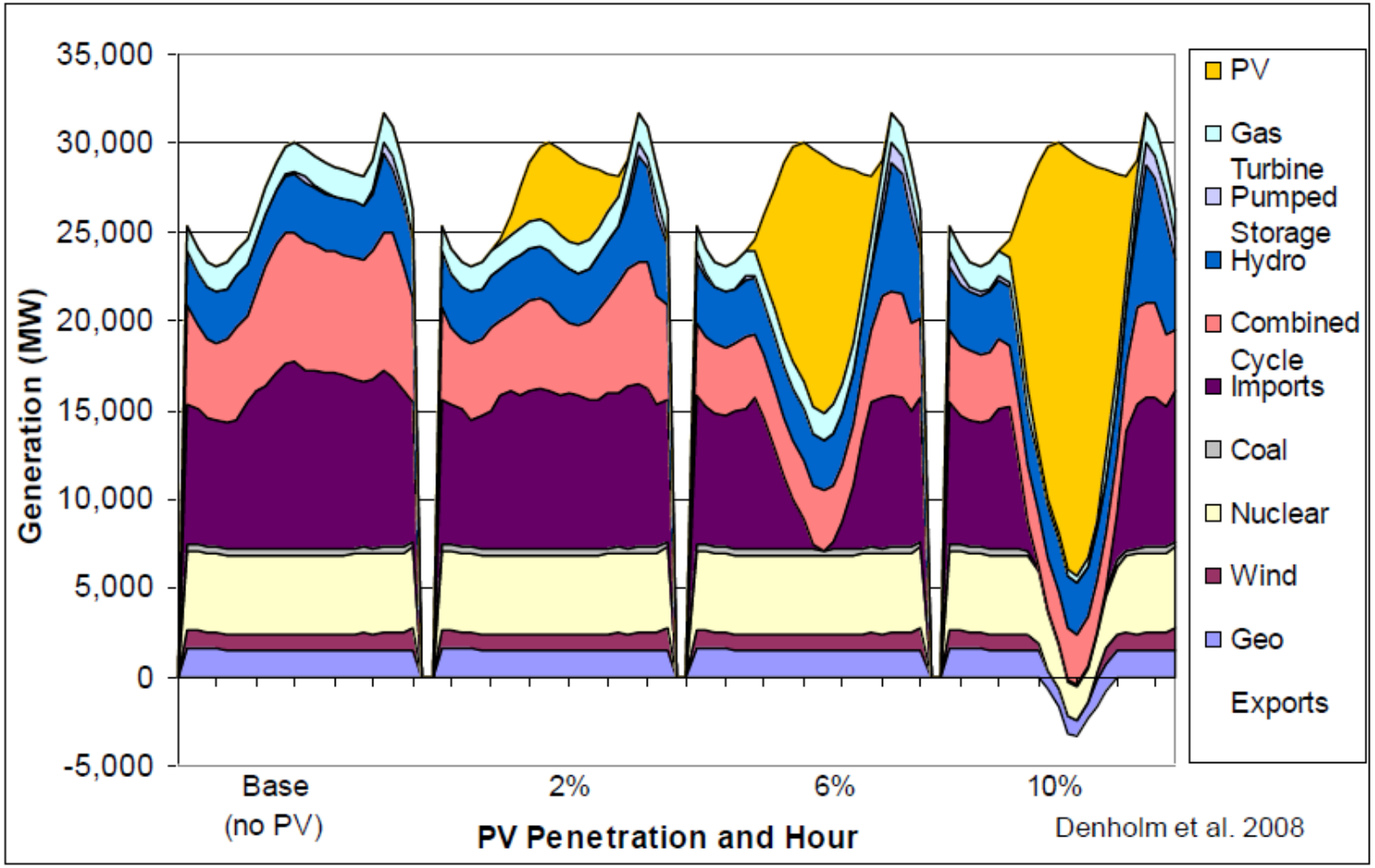
UNMANNED UNDERWATER VEHICLES

FUTURE HYDROGEN AT SCALE "ENERGY ECOSYSTEM"



Source: Pivovar, Hydrogen at Scale NREL

SOLAR VOLTAIC RENEWABLE ENERGY (SPRING)



Simulated dispatch in California for a spring day with PV penetration from 0-10%

Even at low penetrations, instantaneous demand can be met by solar power

Source: Pivovar, Hydrogen at Scale NREL

Summary

- Must recognize that BEV and Fuel Cell Vehicles are both required – NOT an “OR” Discussion
- Use Fuel Cells Where the Make Sense – Support Infrastructure Investments that make this possible
- H_2 - The Universal Energy Translator – It must be Included with Grid Modernization Opportunities
  - Energy Carrier
  - Energy Storage Mechanism
- Under-Promise and Over-Deliver
- Do Not Dilute Station Investments to Point that Scale is Lost
  - California First with ZEV State Fast Followers (North East States)
- Support Work Across Multiple Swim Lanes with Broad Stakeholder Groups
  - New Business Models Required
  - Cross-Industry, Public-Private Collaboration Required (Including Energy & Utility Sectors)
  - Standardized Infrastructure Hardware
- Roles for Collaboration, H2USA – Support above strategies, Broaden Stakeholder Participation

Thank You

Refueling Time

Hydrogen Fuel Cell Technology Enables the Fast Charging

Energy Source	Rate (miles/min)	Long-Trip % Charging Time
Gasoline	150	1-2%
Hydrogen	100	<2%
EV Supercharger	6	15%

Fuel cell vehicles have similar functionality to current Internal Combustion Engines

Battery charging rates (mile/min) limited to about an order of magnitude less than H_2 refueling rates

Assumptions: Gasoline & Hydrogen Electric: 350 mile range, Battery Electric: 250 mile range