The California ZEV Mandate: Policy Origin and Dynamics

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Presentation Overview

- ZEV introductory background
- Methodological choices
- Policy dynamics
- “Lessons learned” and reflections
- Discussion

Broad Research Questions

- Causal questions
  - Why did it happen (in California)?
  - Why did it happen when it happened?
  - What determined the changes in the ZEV mandate?
- Descriptive questions
  - How did the policy evolve?
  - What were the maps of stakeholders' policy beliefs?
  - What were stakeholders' policy strategies?
- Practical questions
  - How useful are theories of the policy process?
  - What have we learned (or should have learned)?

Methodological Approaches

- Chapter 1: Policy origin.
  - Interviews, research of media articles, Multiple Streams Theory
- Chapter 2: Policy dynamics/evolution
  - Interviews, content analysis of public hearings, Advocacy Coalition Framework, multivariate analysis
- Chapter 3: Strategic behavior
  - Game theory, interviews

Contextual Background—The National Level

- The Post-Reagan years: Regulatory Reform receding
- Increasing public awareness
- The environment, central in the Bush-Dukakis debate
- Important rulings in the courts (e.g. NRDC vs. U.S. EPA, 1987)
- An unstable Middle East

Contextual Background—The White House

- "We strongly advocate common efforts to limit emissions of carbon dioxide and other greenhouse gases, which threaten to induce climate change, endangering the environment and ultimately the economy." (President H.W. Bush at the economic summit of industrialized countries in Paris, July 1989.)
- … "a new, more effective Clean Air Act. It will include a plan to reduce, by date certain, the emissions which cause acid rain, because the time for study alone has passed and the time for action is now." (President H.W. Bush, State of the Union Address, February 1989)

Contextual Background—The State Level

- December 31, 1987: CAA deadline for CO, ozone compliance
  - Relaxed in Nov. 1987—notion of “reasonable efforts to comply.”
  - Pressure from environmental groups and US Congress
- SCAQMD, focus of the criticism in California
  - 176 days of ozone non-compliance
  - Clean Air Act and Sierra Club sue EPA
- Northeast: Frustration with EPA inaction.
  - Notion of interstate air pollution lead to the creation of the OTC.
  - Champions like Thomas Jörling, David Cohen, John Olver, Daniel Greenbaum, Trudy Coxe.

Regulatory and Legislative Activity

- Clean Air Act Amendments
  - Debate started in 1988
  - Transportation: Energy and Commerce Committee (Dingell vs. Waxman)
  - Bush's proposal (June, 1989)
  - Auto industry expected new standards would be set
  - Bill passed the Senate on April 3, 1990.
- South Coast's Path to Clean Air
  - More technology-forcing than CAAA
  - First time electric vehicles are required
  - Strong reaction from industry

Regulatory and Legislative Activity (cont.)

- AB 234 (Bill Leonard, 1987)—the methanol move
  - AB 234 Advisory Board
  - The fuel pool
- CA Clean Air Act (Sher Act, 1988)
  - Authorized any “technologically-feasible” standards on vehicles and fuels
  - Directed “the maximum degree of emission reduction possible”
- December, 1989: First draft California LEV program
  - System approach
  - Three tiers: TLEV, LEV, ULEV (0.125, 0.075, and 0.04 g/mile HC)
  - Auto industry opposed, oil industry “guardedly supportive”

Ladies and Gentlemen: The ZEV Mandate

"While meeting the fleet average requirement, each manufacturer's sales fleet of passenger cars and light-duty trucks from 0-3750 lbs, LVW shall be composed of at least 2% ZEVs each model year from 1998 through 2000, 5% ZEVs in 2001 and 2002, and 10% ZEVs in 2003 and subsequent model years.

a. A manufacturer may meet the ZEV requirements by submitting to the Executive Officer a commensurate amount of g/mi NMOG emission credits earned exclusively from the sale of ZEVs. These credits may be earned previously by the manufacturer or acquired from another manufacturer.

b. Manufacturers which sell fewer ZEVs than required in a given model year shall make up the deficit by the end of the next model year, by selling an additional number of ZEVs equal to their deficit or by submitting to the Executive Officer a commensurate amount of g/mi NMOG credits earned exclusively from the sale of ZEVs.

c. Small volume manufacturers shall not be required to meet the percentage ZEV requirements. However, small volume manufacturers may earn and market credits for ZEVs they produce and sell.

d. Intermediate volume manufacturers shall not be required to meet the percentage ZEV requirements before the 2003 model year."

Policy Origin—How did it happen?

- Deterioration of emission-control equipments
- Perception of techno-economic feasibility
  - GM introduces the Impact, January 1990.
  - Limited understanding of the technology and related markets
  - Extrapolation of the right lessons to the wrong case
  - Asymmetry of information and historical mistrust
- Policy entrepreneur—Don Drachand
- Market forces “not sufficient.”
- Mandate immersed in much broader, immediate debate (LEV requirements and fuel mandates)
- Biennial reviews

ZEV State of the Knowledge in 1990

- Lead-acid, predominant battery technology
  - Typical range, 75 miles/charge (Delucchi, et al., 1989)
  - 35 Wh/kg (gasoline, 2,000 Wh/kg)
  - $95/kWh (Delucchi, et al., 1989)
- ARB estimate of excess cost of battery-electric vehicles (BEV) over gasoline internal combustion engine vehicles (ICEV), $1,350-$3,500
- Lifecycle costs of BEVs (28.4 ¢/mile) potentially lower than those of gasoline ICEV (24.7-35.7 ¢/mile)
- ARB was hoping for breakthroughs!

Policy Dimensions: 1990

Policy item	Component		
	Pro ZEV Solution	Anti ZEV Mandate	Pro ZEV Economics
LAW	0.216	-0.717	0.101
NEEDED	0.650	-0.312	0.390
PRO_COST_EFF	0.191	0.734	-0.099
ZEV_COST_EFF	0.279	-0.342	0.771
AIRQUAPROB	0.066	-0.661	0.201
MOBILE	0.689	0.178	0.052
COMMAND	0.302	-0.718	0.452
SALES	-0.480	0.634	0.137
CA_ECONOMY	0.065	-0.038	0.841
HEALTH_LINK	0.475	-0.075	0.501
INNOVATION	0.635	-0.505	-0.165
TECH_READY_NEW	0.801	-0.107	0.397
ZEV_MKT_NEW	0.711	-0.143	0.400
TECH_FORCE	0.735	-0.416	0.144
Cronbach's alpha	0.863	-0.772	0.712
Eigenvalues	5.96	1.83	1.40
Proportion	0.43	0.13	0.10

Source: Collantes (2006)The California Zero-Emission Vehicle Mandate: A Study of the Policy Process, 1990-2004. Ph.D. dissertation.

Policy Coalitions: 1990

Policy-core scale	Cluster				Prob > F
	Anti ZEV Viability	Pro ZEV Mandate Cost Effectiveness	Anti Mandates	Pro ZEV Mandating	
Pro ZEV Solution	-0.97	0.65	0.32	1.02	0.000
Anti ZEV Mandate	-0.27	-0.20	1.27	-0.90	0.000
Pro ZEV Economics	-0.07	2.38	-0.32	-0.54	0.000
Cluster members	AIAM	ARB staff	ARCO	AeroVironment	
	CANGVC	CEC	CAPCOA	CCA	
	CPUC	SMUD	Chevron	LACTC	
	Chrysler		Ford	SCAQMD	
	EMA		GM	Sacramento County Board	
	Honda		SCE	Sierra Club	
	MVMA		Texaco	US EPA	
	Mercedes Benz		WSPA		
	Nissan				
	Senator Rosenthal				
	Toyota				
	Volkswagen				

Source: Collantes (2006)The California Zero-Emission Vehicle Mandate: A Study of the Policy Process, 1990-2004. Ph.D. dissertation.

The 1996 Review: The End of the Mandate?

- Battery Technical Advisory Panel: What was the state of battery technology?
- Demonstration program replaces the mandate
- Memoranda of agreement with automakers
  - Specific numbers of ZEVs deployed, 1996-2000
  - 49-state NLEV program
- The power of Section 177
- 49-state NLEV program

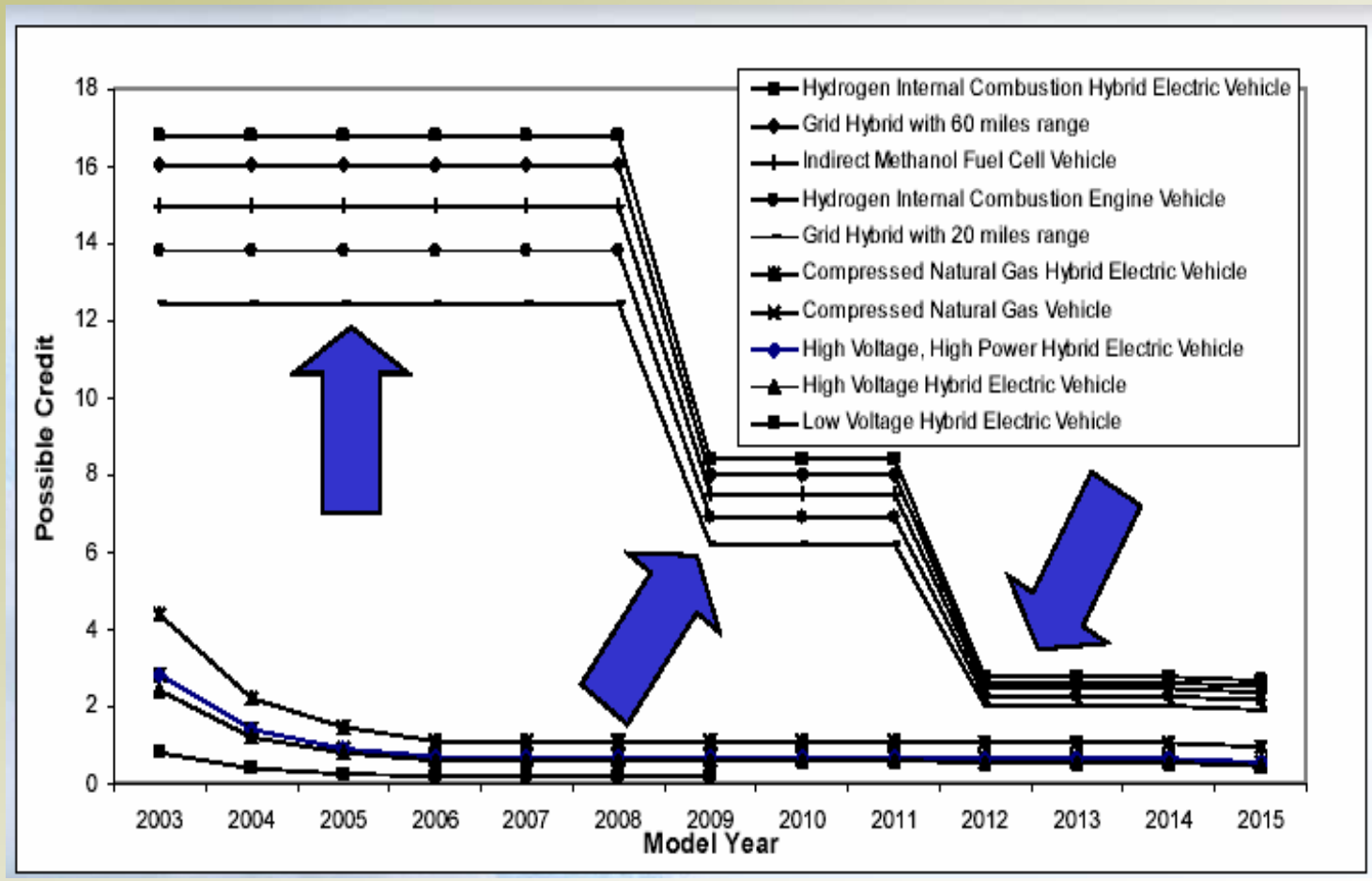
The 2001 Review

- Expert Panel report

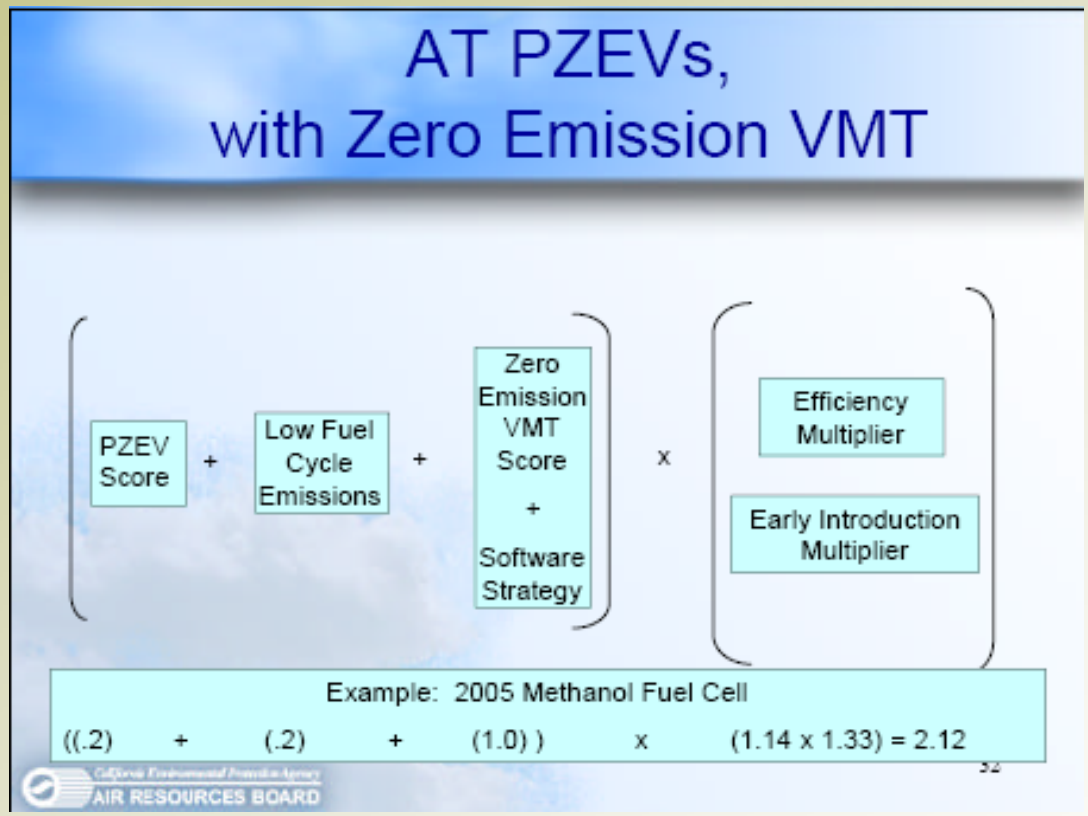
Battery technology	Estimated range [miles/charge]	Specific energy [Wh/kg]	Energy density [Wh/liter]	Specific cost [US$/kWh]	Battery pack cost [US$]	Operating life [years]
Nickel-metal hydride	75-100	65-70	140-170	350*	9,500-13,000*	10
Lithium-ion	n.a.	93-138	114-210	600*	18,000-21,000*	2 to 4
Lithium-metal polymer	n.a.	110-130	130-150	n.a.	n.a.	n.a.
* Estimate based on production levels required to meet 2003 ZEV requirements						

- ZEV requirements upheld
- ATPZEV category added
- Fuel cell vehicles and plug-in hybrids enter the debate
- Technology forcing or “technology following”?
- Environmental justice constituency opposes the program

ATPZEVs: From Simplicity to Complexity

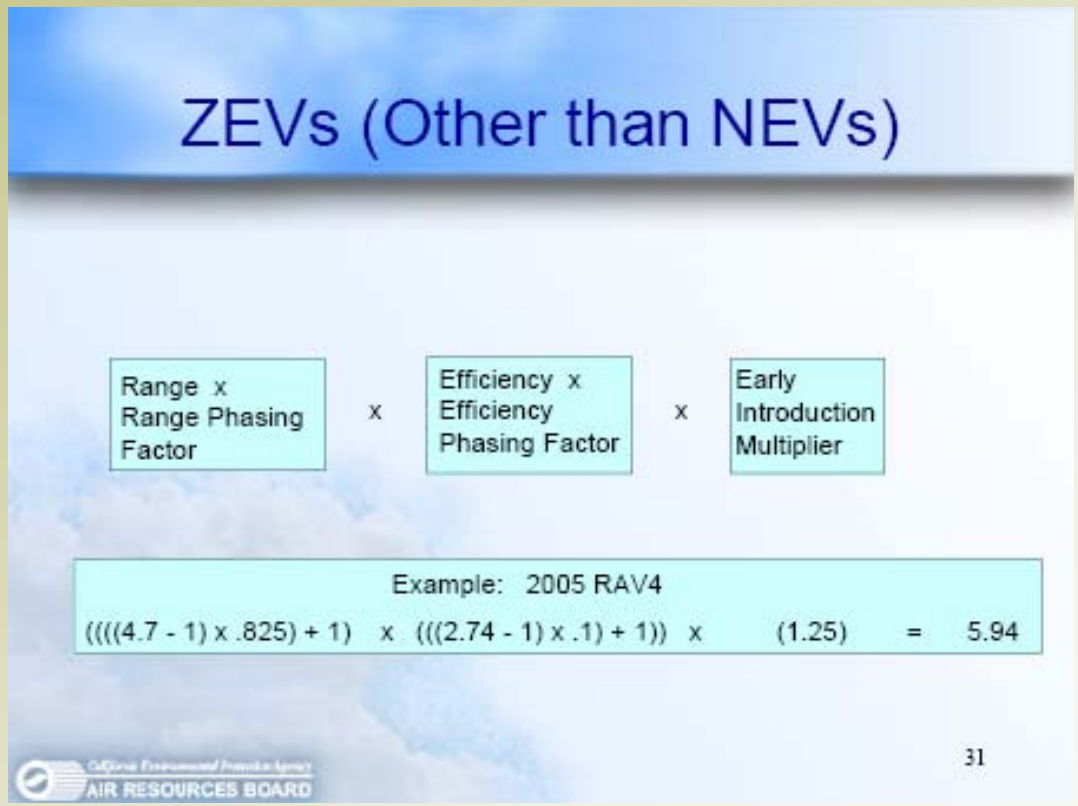


Multiplier System: ATPZEVs



Source: California Air Resources Board

Multiplier System: ZEVs



Source: California Air Resources Board

Technology Options Today

2% ZEV

2% ATPZEV

6% PZEV

Hydrogen Fuel Cell Vehicles: Will They Be Any Different?

On board electricity and new lifestyle uses

Mobile electronics, tools & appliances

Zero emissions, greenhouse gas reductions

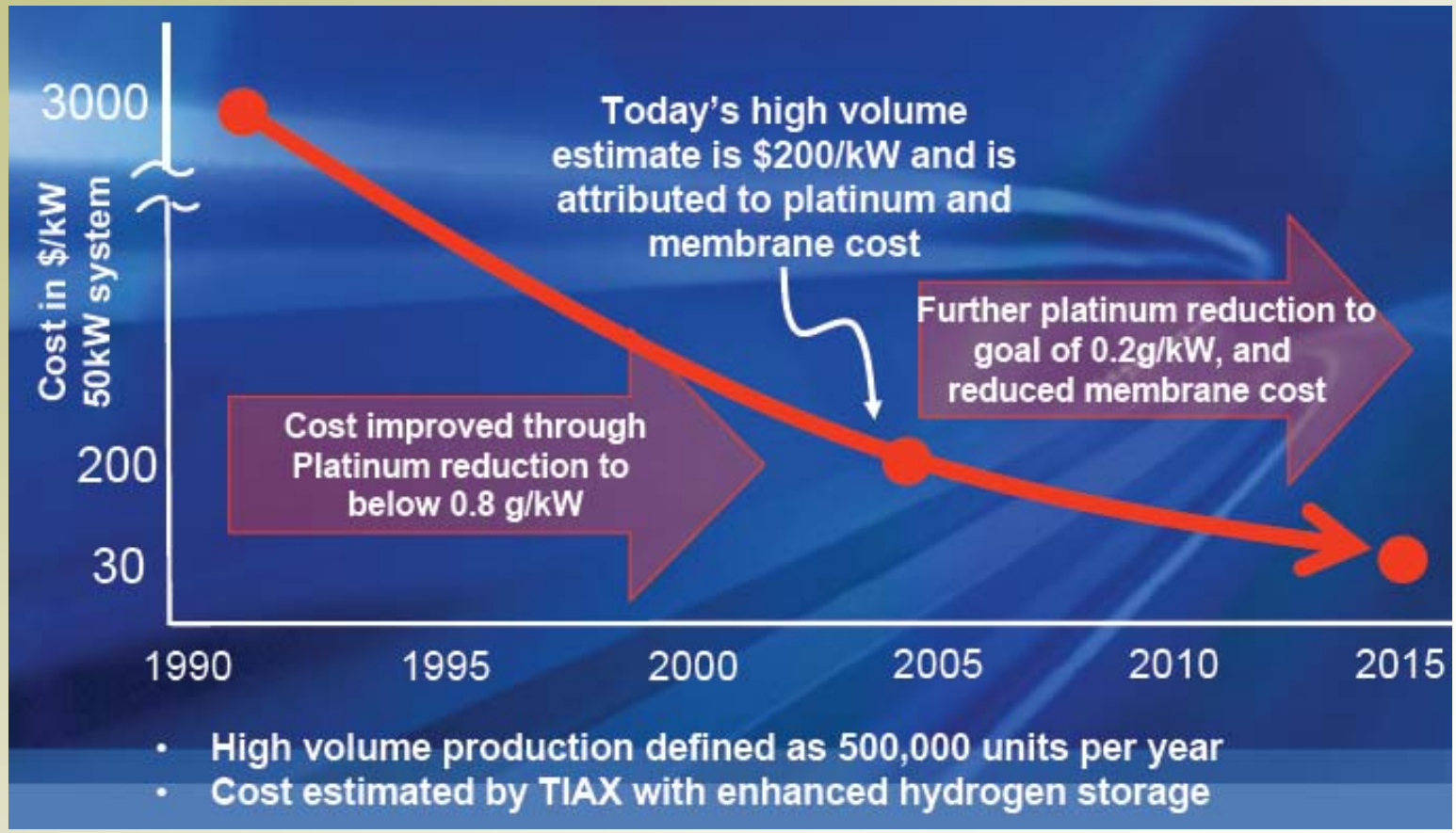
Emergency electricity

Vehicle to grid power

New vehicle designs

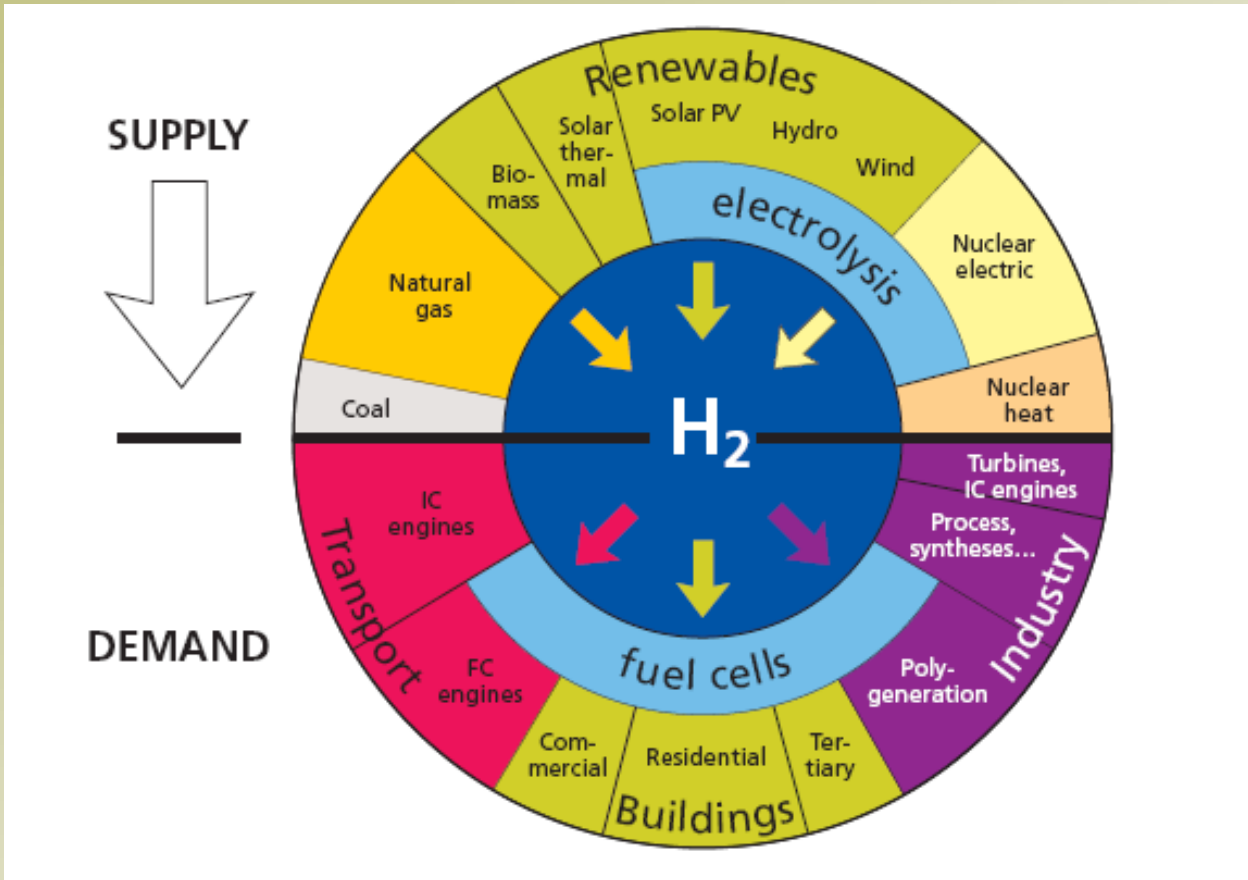
E-drive Performance, feel

Proton Exchange Membrane Fuel Cell Costs



Source: General Motors

Hydrogen and Energy Diversity



DIVERSIFICATION

SYNERGIES

Source: European Commission, Directorate General for Energy and Transport

The Next ZEV Review

- The attempt to regulate CO_2 vehicular emissions
- Waiver requested to EPA: Is CO_2 a criteria pollutant?
- California constituency supportive
- Automakers united in decision to litigate

"What about the state law that requires all automakers to further reduce the emissions of greenhouse gases from new cars in California beginning in 2009?"

	All Adults	Party			Likely Voters
		Dem	Rep	Ind	
Favor	77%	85%	64%	81%	78%
Oppose	17	11	28	16	17
Don't know	6	4	8	3	5

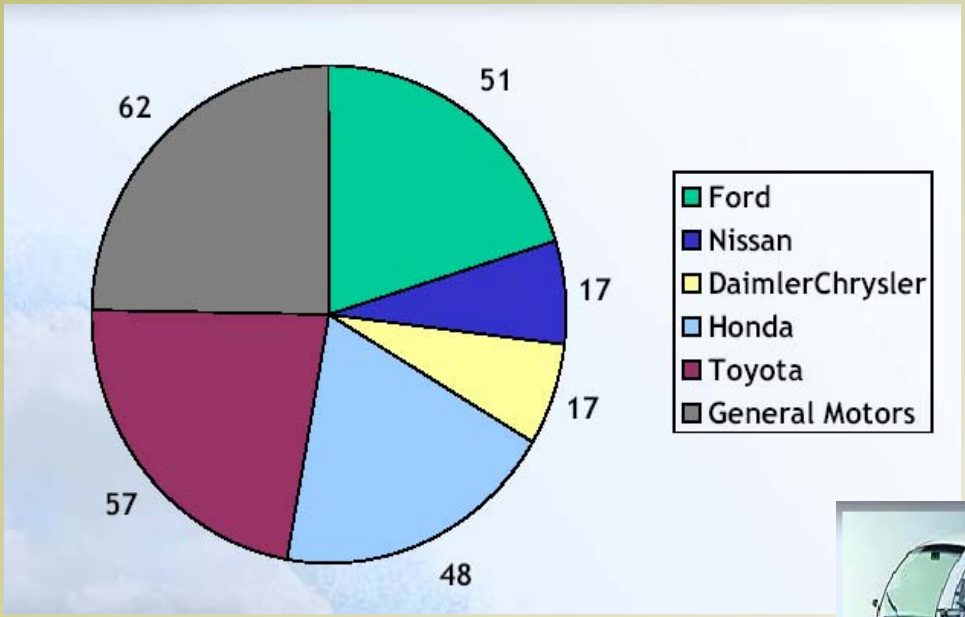
Source: Public Policy Institute of California & Hewlett Foundation (2005)

"Lessons Learned"

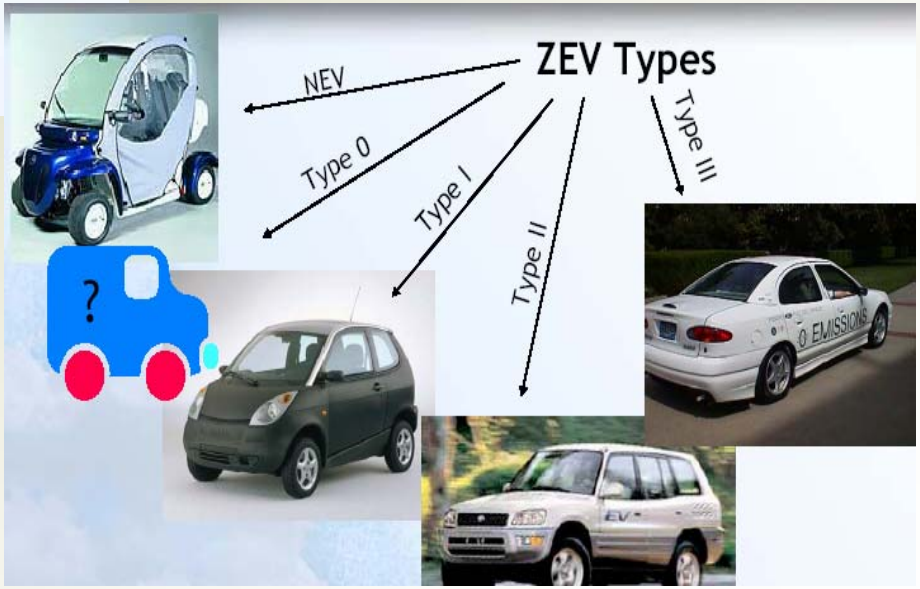
- Implementation: Convergence of multiple factors
- Technology innovation: Importance of demonstration programs
- Section 177, powerful policy mechanism
- Once in, hard to back down
- Has the ZEV mandate/program worked?
  - Getting ZEVs on the roads, **not yet—wait and see**.
  - Inducing ZEV-technology innovation, **yes (with caveats)**
  - Inducing deployment of cleaner vehicles, **yes**
  - Cost-effectively attain policy goals, **no**
  - Moving up the policy learning curve, **yes**

THANK YOU!

Alternative Compliance Path



250 Type III ZEVs (FCVs) required for the 2003-2008 period



Policy Dimensions: 1996

Policy item	Component				
	Pro ZEV Mandate	Pollution Health Effects	Pro Tech Forcing	Pro Staff Proposal	Pro Extant Program
NEEDED	0.730	0.166	0.317	-0.015	0.425
PRO_COST_EFF	-0.931	-0.104	0.013	-0.060	-0.148
PRO_STDBASED	-0.840	-0.030	-0.095	-0.181	0.098
PRO_MKTBASED	-0.701	-0.103	0.260	0.040	-0.302
ZEV_COST_EFF	0.935	0.004	0.030	0.071	0.149
AIRQUAPROB	-0.114	0.510	0.184	0.295	0.382
MOBILE	0.081	0.895	0.085	-0.036	0.225
COMMAND	0.659	0.258	0.382	-0.127	0.466
SALES	-0.544	-0.202	-0.136	0.253	-0.453
CA_ECONOMY	0.815	-0.061	0.153	0.236	-0.081
HEALTH_LINK	0.179	0.890	-0.090	0.176	0.042
INNOVATION	0.093	0.164	0.777	0.085	-0.223
TECH_READY_OLD	0.051	0.213	-0.212	0.137	0.816
TECH_READY_NEW	0.057	0.157	-0.092	0.912	0.098
ZEV_MKT_OLD	0.290	0.116	0.088	0.116	0.865
ZEV_MKT_NEW	0.540	0.093	0.146	0.676	0.132
TECH_FORCE	0.081	-0.098	0.853	-0.084	0.170
Cronbach's alpha	0.908	0.765	0.609	0.760	0.826
Eigenvalues	6.61	2.41	1.72	1.57	1.08
Proportion	0.39	0.14	0.10	0.09	0.06

Source: Collantes (2006)The California Zero-Emission Vehicle Mandate: A Study of the Policy Process, 1990-2004. Ph.D. dissertation.

Policy Coalitions: 1996

Policy-core scale	Cluster						Prob > F
	Moderate		Pro Public Health		Anti ZEV Mandate	Pro Tech Forcing	
Pro ZEV Mandate	0.42		0.30		-2.61	0.14	0.000
Pollution Health Effects	-0.72		1.26		-0.10	-0.01	0.000
Pro Tech Forcing	-0.30		-0.51		-0.14	1.84	0.000
Cluster members	Board Vagim	ABTF	ALA	GM	Assemblyman Baldwin	ARB staff	
	CAMCDA	ALABC	Board Silva	NRDC	Assemblyman Bordonaro	BAT Int'l	
	CalETC	Ballard	CCA	PCL	CAHT	Board Boston	
	EDF	Board Calhoun	CalPIRG	PEM	Senator Haynes	Board Dunlap	
	Honda	Board Edgerton	Chrysler	Toyota	WSPA	Dr. Dixon	
	Integral Design	Board Hilligoss	Ford	UCS		Dr. Frank	
	Mazda	Board Lagarias				Sierra Club	
	NESCAUM	Board Parnell					
	Nissan	Board Riordan					
	SCAAG	Board Roberts					

Source: Collantes (2006)The California Zero-Emission Vehicle Mandate: A Study of the Policy Process, 1990-2004. Ph.D. dissertation.

Policy Dimensions: 2001

Policy item	Component				
	ZEV Program Support	Pro tech forcing	Pollution health effects	Pro Market Ready	Pro Staff Proposal
NEEDED	0.808	0.210	-0.075	0.317	0.141
PRO_COST_EFF	-0.751	0.202	-0.159	0.163	-0.239
ZEV_COST_EFF	0.844	0.003	-0.275	0.081	0.125
AIRQUALPRO	-0.078	-0.140	0.827	-0.103	0.144
MOBILE	-0.120	0.159	0.678	0.040	-0.224
COMMAND	0.440	0.106	-0.116	0.559	0.238
SALES	0.057	0.122	-0.116	-0.827	0.124
HEALTH_LINK	0.013	0.047	0.874	0.020	-0.106
INNOVATION	0.114	0.905	0.063	-0.085	-0.004
TECH_READY_OLD	0.148	-0.220	-0.059	0.456	0.584
TECH_READY_NEW	0.220	0.051	0.000	-0.002	0.870
ZEV_MKT_OLD	0.132	-0.104	-0.130	0.766	0.416
ZEV_MKT_NEW	0.216	0.102	-0.148	0.112	0.824
TECH_FORCE	0.057	0.941	-0.002	-0.085	0.039
SIP	0.841	0.215	-0.040	0.063	0.157
Cronbach's alpha	0.817	0.908	0.719	0.656	0.744
Eigenvalues	4.42	2.28	1.91	1.40	1.26
Proportion	0.29	0.15	0.13	0.09	0.08

Source: Collantes (2006)The California Zero-Emission Vehicle Mandate: A Study of the Policy Process, 1990-2004. Ph.D. dissertation.

Policy Coalitions: 2001

Policy-core scale	Cluster						Prob > F
	Moderate Anti Tech Forcing		Pro Public Health	Pro Tech Forcing	Anti ZEV Air Quality Benefits	Anti ZEV Mandate	
ZEV Program Support	0.18		0.86	0.23	-1.56	-3.40	0.000
Pro Tech Forcing	-0.58		0.20	1.69	-0.71	0.91	0.000
Pollution Health Effects	-0.48		1.42	-0.21	2.17	-0.72	0.000
Cluster members	AAM	CalETC	ALA	ARB staff	Assembly Cardenas	GM	
	Assembly Firebaugh	Dr. Frank	Board Lloyd	Ballard	BHMP	Sierra Research	
	Avestor	Dynasty Motorcar	CBE	Board C. H. Friedman	MELASI		
	BAAQMD	EPRI	CCA	Board Calhoun			
	Board Burke	EVDC	Daimler Chrysler	Energy Conversion Devices			
	Board D'Adamo	Ford	LADWP	Honda			
	Board DeSaulnier	NRDC		Int'l Fuel Cells			
	Board McKinnon	Northern Sonoma CAPCD		NYDEP			
	Board Patrick	PCL					
	Board Riordan	SCAQMD					
	Board Roberts	Toyota					
	Board W. Friedman	UCS					
	CFC						

Source: Collantes (2006)The California Zero-Emission Vehicle Mandate: A Study of the Policy Process, 1990-2004. Ph.D. dissertation.

Policy Dimensions: 2003

Item	Component				
	Pro Extant Program	Pro Staff Proposal	Pollution Health Effects	Anti Tech Forcing	Anti Command and Control
NEEDED	0.215	0.592	0.458	-0.082	-0.149
AIR_QUALITY_PROB	0.016	-0.097	0.795	0.055	-0.343
MOBILE	-0.200	-0.111	0.777	0.080	0.231
COMMAND	0.063	0.274	0.134	-0.455	-0.640
SALES	-0.368	-0.003	0.003	0.202	0.618
CA_ECONOMY	-0.148	-0.035	0.056	0.212	-0.798
HEALTH_LINK	-0.027	-0.006	0.760	-0.072	0.022
INNOVATION	-0.125	0.028	-0.151	-0.850	-0.048
TECH_READY_OLD	0.743	-0.090	-0.041	0.077	0.017
TECH_READY_NEW	-0.089	0.847	-0.125	0.079	0.044
ZEV_MKT_OLD	0.878	0.030	0.039	0.063	-0.086
ZEV_MKT_NEW	0.119	0.831	-0.123	-0.095	-0.011
TECH_FORCE	0.130	0.036	0.107	-0.870	0.012
SIP	-0.246	0.166	-0.543	-0.024	0.367
FCV_PROMISE	-0.469	0.602	-0.256	-0.155	-0.054
BEV_PROMISE	0.897	0.139	-0.074	-0.265	-0.092
Cronbach's alpha	0.817	0.723	0.703	0.719	0.534
Eigenvalues	3.14	2.81	2.28	1.60	1.33
Proportion	0.20	0.18	0.14	0.10	0.08

Source: Collantes (2006)The California Zero-Emission Vehicle Mandate: A Study of the Policy Process, 1990-2004. Ph.D. dissertation.

Policy Coalitions: 2003

Policy-core scale	Cluster				Prob > F
	Pro Extant Program's Health Benefits	Pro New Proposal	Anti Extant Program	Pro Tech Forcing	
Pro Extant Program	0.75	-0.50	-0.82	0.36	0.000
Pro Staff Proposal	0.04	2.23	-0.35	-0.51	0.000
Pollution Health Effects	0.83	-0.31	-0.40	-0.38	0.001
Anti Tech Forcing	0.58	-0.21	0.40	-1.17	0.000
Cluster members	AC Propulsion	ALA	BAAQMD	Avestor	
	Board C. H. Friedman	ARB staff	Board Burke	Board D'Adamo	
	CCA	EPRI	Board Calhoun	CalStart	
	CalETC	NRDC	Board DeSaulnier	Compact Power	
	City of Fresno	UCS	Board Lloyd	Dr. Frank	
	EV Works		Board McKinnon	Evercel Inc.	
	Electricab Corp		Board Riordan	Hydro Quebec	
	Global Motor		Board Roberts	Kirsch Foundation	
	Green Car Institute		Board W. Friedman	NY DEC	
	Mobility Lab		Dr. Anderman	SCAQMD	
	PCL		Dr. Santini	SMUD	
	PEVDC		Ford	Sierra Club	
	Phoenix Motorcars		Honda		
	SCE		LADPW		
	Stanislaus County		MA DEP		
			Toyota		

Source: Collantes (2006)The California Zero-Emission Vehicle Mandate: A Study of the Policy Process, 1990-2004. Ph.D. dissertation.