

**Mendocino Council of Governments**  
**Zero Emission Vehicle (ZEV) Demonstration Project**  
**Phase II Final Report**

Executive Summary

Introduction. The purpose of the ZEV Demonstration Project was to evaluate the practicality of using zero emission vehicles, in this case commercially produced electric vehicles (EVs), in the rural setting of Mendocino County and generate a report of findings. The project initiated informed EV infrastructure planning efforts by providing hands-on experience for local government agency and planning personnel. This report can be disseminated to other rural areas with similar concerns.

Lead agencies and funding. The ZEV Project - Phase II was Work Element #13 in the Mendocino Council of Governments' (MCOG) 1997/98 and 1998/99 Overall Work Program, part of MCOG's role as the Regional Transportation Planning Agency. The project was managed by the Renewable Energy Development Institute (REDI), a charitable nonprofit educational and scientific corporation in Willits, California. This second phase was co-funded by the State Legislature with Petroleum Violation Escrow Act (PVEA) funds, through the California Energy Commission (CEC). (*See attached detail of funding*)

Previous work. The ZEV Project - Phase I was conducted as a feasibility study, part of the 1996/97 Overall Work Program, funded by MCOG and by public-private in-kind contributions. Phase II was conducted based on recommendations made.

Regional Priorities. The ZEV Project responds to state and federal mandates, the first priority in regional planning. According to MCOG's Overall Work Program (*see excerpts attached*), the ZEV Project also addresses two other regional transportation planning priorities, by "Creating Effective Partnerships" and "Utilizing New Technology."

Response to state and federal mandates. As the name suggests, the ZEV Project participates in statewide clean air strategies by demonstrating electric vehicles. California's Clean Air Act of 1990 is enforced by the Air Resources Board rules known as the ZEV Mandate, which has been weakened in recent years but is still in force. The amended schedule of EV deployment calls for four percent ZEVs in the state by 2003 (*refer to ZEVolutions publication in Appendix*). The ZEV Project also responds to the Clinton-Gore Administration's National Environmental Technologies Strategy.

Other issues. In addition, the ZEV Project responds to issues of global warming caused by greenhouse gas emissions. An important part of the project is the demonstration of solar net metering. By addressing opportunities with renewable energy sources, the project further responds to the need for energy efficiency and conservation. These three main forces--clean air laws, global warming, and energy security-- are driving the development of new advanced vehicle technologies.

Rural emphasis. This is a rural demonstration and therefore different from work done to date with EV technology, which so far has been focused on urban areas with problems of air quality attainment status. It deals with pollution prevention in a relatively pristine environment, as a practical strategy to keep air attainment status through good planning. The project also deals with the challenges of more rugged and mountainous terrain, a somewhat colder climate, and remote locations.

Objectives of the project. The following were the state and local objectives.

*PVEA Objective:*

- Report energy savings during project (*see attached CEC formula*)

*Work Element 13 Products:*

- Report on rural trial performances
- Forecast of infrastructure requirements
- Data for countywide air quality and transportation plans
- Solar photovoltaic net metering demonstration

How objectives were accomplished. The above objectives were accomplished by the following OWP work element tasks, Phase I recommended approaches, and through extensive research. These have been completed and are incorporated in this report.

*Work Element 13 Tasks:*

- Install EV charging stations
- Acquire and test vehicles, train drivers, collect data, demonstrate to public
- Install solar net metering demonstration
- Document and present findings

*Phase I Recommended Tasks:*

- Compare vehicle performance in day-to-day use
- Collect and log driver experience and vehicle performance data
- Determine the best applications locally of EVs tested
- Address transportation planning and infrastructure
- Consider other factors of EV use
- Assess effectiveness of mitigating local air quality concerns
- Provide photographic documentation
- Develop educational materials specific to the project
- Prepare press releases for public outreach

Education was offered through presentations at schools, other public workshops, ride-and-drive events, REDI's "Tips" package available by request, an additional report format designed for MCOG and REDI's web sites on the Internet with links to other sites, and public copies of the final report made available.

Partners. ZEV Project participants represent a public-private partnership including these agencies and businesses in addition to MCOG, REDI and CEC.

*The five MCOG member jurisdictions of County of Mendocino, and Cities of Ukiah, Fort Bragg, Willits, and Point Arena*

*Other public agencies including Mendocino Transit Authority, County of Mendocino Air Quality Management District, and Brooktrails Township Community Services District, Ukiah High School, Pomolita Middle School, Sacramento Municipal Utilities District*

*The private sector including Pacific Electric Vehicles, Plan-It, InnEVations, Homestead Enterprises, EV Transport, Burkhardt Turbines, Pacific Gas & Electric Company, Glenmoor Enterprises, Green Motorworks, Toyota Motor Sales USA, Ford Motor Company, It's Electric, Daimler-Chrysler Corporation, Energy Conversion Devices, Inc., Solar Electric Specialties/Applied Power Company, Earthlab Energy Systems, and Trace Engineering*

Consumer and fleet emphasis. The EVs tested are designed for fleet and mainstream consumer markets. In other words, they are commercial production vehicles, a further evolution of earlier electric vehicle experimental models, prototypes, kits and conversions that have been displayed at REDI's Solar Energy Expo & Rally and REDI Conference events. While the earlier generation of EVs continue in use in Mendocino County and elsewhere, many consumers have waited for the new production EVs.

*The new generation of EVs addresses consumer and fleet needs such as:*

- Safety standards
- Manufacturers' service and support
- Insurance coverage
- Lease and purchase options
- Comfort features such as air conditioning and audio systems
- Acceptable performance compared to gasoline vehicles

Findings and conclusions. The following is a synopsis of findings, which are described in greater depth throughout the report.

*Recommendations on rural uses for each vehicle tested:*

**General Motors EV1.** This two-seat sport coupe is good for commuting. The model tested uses lead-acid batteries. For intercity commuters, this necessitates recharging during peak-demand hours. The new model with NiMH batteries would need to be charged only at one end of a round-trip commute, during off-peak hours. Either EV1 model would be well suited to town use or flat valley areas, including freeway driving. The extremely lightweight design makes this EV very energy efficient.

**Toyota RAV4-EV.** This compact sport utility vehicle with NiMH batteries performed well under all of the rigorous conditions tested in Mendocino County and is recommended for general use. It was tested during extremely hot weather, and even using the air conditioning it had plenty of range and power.

**Ford Ranger EV.** The 1998 model of this pickup truck with lead-acid batteries was limited in range, as was the EV1. The 1999 model with NiMH batteries increases the payload for utility applications, as they are lighter weight, and also should increase range for intercity use. The 1998 lead-acid Ranger performed well climbing hills and maintaining highway speeds, but was tested without cargo. For utility purposes, the NiMH model is expected to be more useful.

**Solectria Force EV.** This four-door compact sedan makes a useful town or valley vehicle, and is recommended for short trips as opposed to intercity commutes. The regenerative braking feature extends the range, but this EV does not maintain freeway speeds well, and works optimally at 45 mph according to the manufacturer. It was also under powered for the steep, hilly residential neighborhoods, but the “regen” feature was very effective going downhill.

**Chrysler EPIC minivan.** Accomodating up to eight passengers, this minivan with NiMH is well suited to public transit and family use. Despite the heavier weight, power seemed sufficient for all of the rural tests, although it was not tested fully loaded with passengers on the more challenging routes. With few passengers, it had no trouble with Mendocino County’s steep terrain. The loaded vehicle did well with the flat valley driving of the transit routes tested, and its already fast charge time can be improved with the 440V charging option. This EV does use more energy than the lighter EVs.

*EV charging infrastructure:*

Charging stations to support EV use were recommended in strategic locations throughout the county, at six to eight initially (four of which are already operating). Further stations could be developed, as outlined in the attached Phase III proposal. A key issue is cost of electric “fuel,” therefore attention should be paid to utility rates. Charging during off-peak hours is recommended. Solar net metering is another option. Recreational vehicle (RV) plug/receptacles were found compatible with all of the EVs tested and are cost effective. The EV industry has not yet settled on a standard and is still divided on choices of inductive vs conductive charging infrastructure.

*Assessment of the effectiveness of mitigating local air quality concerns:*

A countywide air quality study and emissions inventory completed earlier this year identified two key factors as a main focus, particulate matter (PM) and ozone. Ozone precursors are at far higher levels than previously thought. The volatile organic compounds (hydrocarbons) that lead to ozone formation are from vehicles,

the largest source of pollution in the county. Mendocino County consumes four times more gasoline than the statewide average. The study raised many questions and no specific mitigations were recommended, pending further study. In our opinion, because of the findings of transportation related pollution, EVs should be considered for any future mitigation measures.

Source: “A Study of Air Quality Conditions, Including Emissions Inventory, Ozone Formation, PM10 Generation and Mitigation Measures, for Mendocino County, California” prepared for the County of Mendocino Air Quality Management District by Sonoma Technologies, Inc., January 1999.

*Transportation planning considerations:*

Safety issues for electric vehicles were researched, all of which can and are being dealt with, through this project and industry wide. Traffic patterns could potentially improve, with EV drivers diverted away from congested areas to different refueling locations. Appropriate use of various EV models and types was considered in relation to traffic patterns.

*Solar net metering demonstration:*

Recent legislation in California and nationwide now is allowing small-scale renewable energy systems to directly interface with power grids and produce electricity locally. In utilizing renewable energy, the power production does not necessarily match the use of the vehicle, so the energy needs to be stored. Because of net metering, renewable energy produced from solar photovoltaic modules can be stored in the power grid and drawn out as needed to charge the vehicles.

*Multimodal / intermodal transportation centers:*

Multimodal transit center design is a key focus for future efforts. These should incorporate photovoltaic shade/shelter structures in parking designs with consideration for use of Neighborhood Electric Vehicle (NEV) station cars as demonstrated by the BART Station Project. This approach would be well suited to transit center designs currently in progress for the rehabilitation of rail depots in Mendocino County, and would enhance tourism and economic development.

Recommendations for followup or ongoing activities. As of this writing, MCOG has no specific future intent to maintain or further develop the ZEV Project. However REDI, as a nonprofit organization, is an appropriate entity to safeguard some of the ZEV Project investment of infrastructure, along with the Cities of Ukiah and Willits and other local agencies, such as Mendocino Transit Authority, County of Mendocino Air Quality Management District, and the railroads, as well as private local companies. Further funding and commitments for in-kind contributions and participation would be needed to develop the activities that were started.

*Recommendations and future intent for further ZEV activities include:*

- Maintenance of the two EV charging stations installed in Ukiah and Willits
- Maintenance of the solar net metering demonstration in Willits
- Input and testimony to the rewrite of Mendocino County's General Plan and MCOG's Regional Transportation Plan
- REDI's ongoing educational efforts through its library, web site, and other programs
- Funding proposals such as REDI's Phase III proposal to install more charging stations
- Multimodal transit center design with solar shaded parking designs and NEV station cars

It has been a great pleasure to lead this project. The ZEV Demonstration Project would not have been possible without the support of the MCOG and REDI Boards of Directors and State Senator Mike Thompson (now Congressman), the encouragement of my project advisors, and all those who participated. The findings clearly indicate that there are practical uses for clean air vehicles in Mendocino County's transportation scheme, to the public's benefit. I look forward to continuing our efforts together in this important work.

Janet Orth  
ZEV Project Coordinator  
Renewable Energy Development Institute  
Willits, California

July 30, 1999

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