CURRICULUM VITAE – With Detailed Project Descriptions

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1. Proposed position:

2. Name of Firm: Rezachek & Associates

3. Name of Staff: Dr. David Rezachek, P.E.

4. Nationality: United States

5. Education:

1991 Ph.D., Ocean Engineering. University of Hawaii at Manoa, Honolulu, Hawaii, USA

1980 M.S., Mechanical Engineering. University of Hawaii at Manoa, Honolulu, Hawaii, USA

1976 B.S., Environmental Technology and Urban Systems, Florida International University, Miami, Florida, USA

1972 B.S., Chemistry, University of Minnesota, Minneapolis, Minnesota, USA

6. Membership of Professional Associations:

- Professional Mechanical Engineer, State of Hawaii, No. 5485 (1983)
- Affiliate Grad Faculty, Department of Ocean and Resources Engineering, SOEST, University of Hawaii at Manoa
- Member, American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE)
- Member, American Society of Mechanical Engineers (ASME)
- Member, American Solar Energy Society (ASES)
- Member, American Wind Energy Association (AWEA)
- Member, International Solar Energy Society (ISES)
- Member, Life of the Land (Hawaii)
- Member, Union of Concerned Scientists (UCS)

7. Other Training:

1973 U.S. Navy Nuclear Power Plant Prototype, USA
1973 U.S. Navy Nuclear Power School, USA
1972 U.S. Navy Officer Candidate School, USA

8. Countries of Work Experience:

USA, French Polynesia, Germany, Sweden

9. Languages:	***Speaking***	***Reading***	***Writing***
English	good	good	good
German	-	fair	-

10. Employment Record:

From:	1993 To: Present
Employer:	Rezachek & Associates
Positions held:	Owner/Principal Consultant
From*:*	2003 To: 2009
Company:	Honolulu Seawater Air Conditioning, LLC (through Rezachek & Associates)
Positions held:	Associate Development Director/Consultant
From:	1987 To: 2003
Company:	State of Hawaii – Department of Business, Economic Development, and Tourism - Energy Division
Positions held:	Alternative Energy Engineer/Alternative Energy Specialist
From:	1980 To: 1987
Company:	Hawaiian Sugar Planters' Association
Positions held:	Assistant Mechanical Engineer
From:	1980 To: 1980
Company:	Hawaii Natural Energy Institute (HNEI), University of Hawaii at Manoa
Positions held:	Graduate Research Assistant
From:	1979 To: 1980
Company:	Hawaii Natural Energy Institute (HNEI), University of Hawaii at Manoa
Positions held:	Junior Researcher
From:	1978 To: 1979
Company:	Center for Engineering Research (CER), University of Hawaii at Manoa
Positions held:	Graduate Research Assistant
From:	1976 To: 1977
Company:	Department of Oceanography, University of Hawaii at Manoa
Positions held:	Graduate Research Assistant
From:	1974 To: 1976
Company:	Associate Quality Assurance Engineer
Positions held:	Quality Assurance Department, Design Group, Florida Power & Light Company
From:	1974 To: 1974
Company:	Advanced Reactors Division, Westinghouse Electric Corporation
Positions held:	Project Engineer
From:	1972 To: 1974
Company:	U.S. Navy
Positions held:	Student/Officer (Ensign, Lt. JG)

11. Detailed Tasks Assigned	12. Work Undertaken that Best Illustrates Capability to Handle the Tasks Assigned
	Name of assignment or project: Renewable Energy and Energy Efficiency Project for the Roman Catholic Church (RCC) in the State of Hawaii / Renewable Energy and Energy Efficiency Project for the Mary, Star of the Sea Parish Complex **Year:** 2009 to Present **Location:** Hawaii, USA (all islands) **Client**: Roman Catholic Church in the State of Hawaii **Main project features**: Assist in the development of renewable energy and energy efficiency projects for 66 Parishes, including 43 Schools, located throughout the State of Hawaii, Catholic Charities and The Office of Social Ministry, Hilo. **Positions held**: Consultant/Vice Chair – Energy Conservation Evaluation Committee **Activities performed/to be performed**: • Help to further develop and refine Project Objectives and a Project Description. • Serve as a member of the RFQ evaluation and selection committee to help select the Project Developer. • Help identify key project goals and criteria (e.g., GHG emissions reductions, "zero-energy", comfort, reliability, constant cost, etc.) • Help develop a scope of work and to review technical aspects of contract provisions. • Assist in working with Project Developer to approve Project Developer's subcontractors and consultants. • Work closely with Project Developer's Project Manager. • Participate in selected project coordination and project progress meetings with Project Developer. • Participate in selected energy audits to observe and evaluate approach of Project Developer. • Review proposed Energy Conservation Measures (ECMs) and renewable energy applications and make recommendations. • Help identify final ECMs and renewable energy applications to develop. • Review project plans and energy savings, energy generation, and cost calculations and assist in approval of final detailed design. • Review and comment on project-related feasibility studies. • Assist in developing and coordinating a work schedule.

	Activities performed/to be performed for RCC (continued): • Assist in determining if the ECM energy savings (and energy production in the case of Renewable Energy Measures [REMs]) are reasonable, realistic, and not overstated. • Assist in checking any stipulated values for reasonableness. • Assist in evaluating and modifying and approving any necessary change orders. • Assist in identifying and selecting appropriate International Performance Measurement and Verification Protocols (IPMVP) for each project. • Serve as owner's representative for project(s) commissioning.

	Name of assignment or project: Independent Market Advisory Services to the Department of Energy (DOE) in Support of a Loan Guarantee Application from First Wind Holdings LLC **Year:** 2009 to Present **Location:** Honolulu and Kahuku, Hawaii, USA **Client**: Subcontractor to Boston Pacific Company, Inc., Washington, DC, USA **Main project features**: Conduct due diligence activities related to a U.S. DOE loan to First Wind Holdings LLC for a $139 million 30-$MW_e$ wind/15 MW_e dry-cell battery and power system (Battery Energy Storage System [BESS]) **Positions held**: Market Advisory Services Team Member/Consultant **Activities performed/to be performed**: • Provide DOE with an assessment of the viability of First Wind's proposed business plan and Oahu, Hawaii power market economics. • Provide DOE with an assessment of First Wind's business plan, financial model and projections, competitor review, and an assessment of the regulatory and market environment. • Verify that the Project's pro-forma financial projections, including the underlying assumptions, are feasible and achievable given past, current and future price and cost parameters for power in the Oahu, Hawaii electricity market. • Provide a report to DOE that will identify any issues with respect to the market aspects of the Project, evaluate whether or not First Wind's business model will enable a reasonable prospect for repayment of the proposed loan to the Project, and identify potential risks to the Project and DOE. This report should include the following: o Review of First Wind's Business Plan o Review of Financial Projections and Model o Industry and Competitor Review o Analysis of Legal and Regulatory Environment

	Name of assignment or project: Development of a Renewable Energy and Energy Efficiency Project for the Mary, Star of the Sea Parish Complex (MSOS) **Year:** 2009 to Present **Location:** Honolulu, Hawaii, USA **Client**: Star of the Sea Parish/Roman Catholic Church in the State of Hawaii, Honolulu, Hawaii, USA **Main project features**: Development of an up to 409 $kW_{p,e}$ photovoltaic (PV) system to provide power for 259 tons of air conditioning and other electricity uses at the complex. A solar thermal-absorption air conditioning system may be substituted for a portion of the PV-powered conventional air conditioning system. **Positions held**: Engineering Consultant **Activities performed/to be performed**: • Review and evaluate information, regarding the subject Project, provided by a prospective developer, MSOS, and the Roman Catholic Church in the State of Hawaii. Identify, review, and evaluate any additional information required to complete the independent evaluation. • Conduct a site visit to the Mary, Star of the Sea Parish Complex. Tour the complex. Collect additional information regarding this facility required to complete the independent evaluation. • Prepare and submit a final report to MSOS, with a copy to the Diocese. Respond to any questions and concerns of MSOS, or the Diocese. Incorporate any comments provided into the final report. • Help to further develop and refine Project Objectives and a Project Description. • Serve as a member of the RFQ and RFP preparation, evaluation, and selection committees to help select the project developer.

	Name of assignment or project: Development of a Hydro Power Business Development Plan for Hawaii **Year:** 2008 - 2009 **Location:** Hawaii, USA **Client**: M.A.M.M.U.T electric GmbH, Munich, Germany **Main project features**: The objective of this study was to assist M.A.M.M.U.T Electric GmbH in the creation of a hydro power business development plan for Hawaii. **Positions held**: Consultant **Activities performed**: • Identified all feasible potential hydro power project sites (existing dams, run-of-river, pumped storage, in-line) rated at, or above, approximately 500 kW on each island and in each utility service territory. • Obtained topographic maps, photographs, and other pertinent information for each feasible potential project site. • Conducted a preliminary analysis of available head, available flow (minimum, maximum, and temporal variations), design output power, and energy yield for each potential project. • Evaluated proximity of the electrical grid, grid capacity, and grid interconnection requirements and costs. • Determined land ownership and zoning for each potential hydro site and identified any “exclusion zones” where hydro power plant development may be prohibited. • Identified previous attempts to develop any of these potential hydro projects and collected and summarized related information. • Identified market and institutional barriers to the commercialization of hydro power in Hawaii. • Identified legislative and regulatory issues (e.g., local, state, and federal legal restrictions on the development of the hydro site and the use of the water). • Identified potential environmental impacts, licensing, and permit requirements. • Identified appropriate government agency, political, and environmental group contacts. • Identified potential financing mechanisms for hydro power facilities in Hawaii. • Identified any available tax credits and other incentives. • Provided information on Special Purpose Revenue Bonds.

Name of assignment or project: Downtown Honolulu Seawater Air Conditioning (SWAC) Project

Year: 2003 - 2009

Location: Honolulu, Hawaii, USA

Client: Honolulu Seawater Air Conditioning, LLC (HSWAC)

Main project features: Development of a $245 million 25,000-ton seawater air conditioning (SWAC) district cooling system for downtown Honolulu, Hawaii

Positions held: Associate Development Director/Consultant

Activities performed:

- Developed a heat map (cooling loads) for the downtown Honolulu service area (90+ buildings).
- Developed a preliminary chilled water distribution system layout.
- Identified and met with potential customers.
- Assessed the performance and costs of potential customers' conventional air conditioning systems.
- Developed a business plan for HSWAC.
- Involved in all aspects of the seawater delivery and return system and cooling station design.
- Provided detailed economic analyses (life cycle cost analyses, input-output analyses of economic and fiscal impacts).
- Provided detailed performance analyses (relative to conventional cooling).
- Participated in due diligence processes related to equity financing.
- Participated in environmental assessment activities (including the preparation of Environmental Impact Assessments) and permitting (federal, State, and county).
- Met with numerous energy, environmental, and engineering groups and public officials (more than 150) to provide information regarding SWAC and to address various concerns.
- Assisted in determining the benefits provided by SWAC towards meeting the United States Green Building Council's (USGBC) Leadership in Energy and Environment Design (LEED) and the Environmental Protection Agency's (EPA) ENERGY STAR rating standards.
- Drafted legislation, and prepared and presented testimony, to have SWAC included as an eligible technology for the State of Hawaii's Enterprise Zone Program.
- Drafted legislation, prepared and presented testimony, and achieved passage of a Joint House/Senate Resolution stating the legislature's support for HSWAC and calling for a feasibility analysis for the use of SWAC in State buildings and which also stated that SWAC is recommended to be the preferred air conditioning system for State facilities where feasible and available if the analysis provides a lower life-cycle cost, including environmental costs.
- Drafted, prepared and presented testimony, and achieved passage of legislation for exemption of SWAC systems from PUC regulation.

	Activities performed for HSWAC (continued): • Drafted, prepared and presented testimony, and achieved passage of legislation to allow direct negotiation of leases/easements for SWAC systems for State/county property. • Drafted, prepared and presented testimony, and achieved passage of legislation to require priority processing of State and county permits for renewable energy projects such as SWAC. • Drafted, prepared and presented testimony, and achieved passage of legislation which authorizes issuance of $145,000,000 in special purpose revenue bonds (SPRBs) to Honolulu Seawater Air Conditioning LLC for the purpose of the planning, design, and construction of a seawater air conditioning (SWAC) district cooling system in downtown Honolulu. • Drafted, prepared and presented testimony, and achieved passage of legislation to require the government of the State of Hawaii to significantly improve its energy management in state facilities in order to save taxpayer dollars and reduce emissions that contribute to air pollution and global climate change. • Identified a number of federal, State, and county legislative initiatives that could be used to support SWAC development. • Participated in numerous Integrated Resources Planning and energy planning processes on behalf of Honolulu Seawater Air Conditioning LLC. • Prepared a number of detailed analyses to support HSWAC's case for raising the current HECO rebate for SWAC over the last 3+ years. Rebate recently raised to $ 300/ton. • Prepared and presented testimony, and helped achieved passage of legislation that establishes as state policy statewide greenhouse gas (GHG) emissions limits at or below the statewide GHG emissions levels in 1990 to be achieved by January 1, 2020 and establishes GHG emissions reduction task force to prepare a work plan and regulatory scheme to achieve the statewide GHG emissions limits. • Preparing an alternative (to HECO's) Integrated Resource Plan which provides for more aggressive renewable energy and demand side management development and which will allow HECO to meet State of Hawaii 2020 greenhouse gas emissions reduction requirements. • Worked with Hawaii's U.S. congressional delegation to obtain legislative and other support for SWAC and renewable energy development in Hawaii. • Prepared an analysis of imported oil savings and greenhouse gas emissions reductions from 100,000 tons of SWAC as well as equivalents for other renewable energy and energy efficiency alternatives.

	Name of assignment or project: Evaluation of Various Renewable Energy and Conventional Energy Technologies for Large, Multi-National Corporations **Year:** 2007 and 2008 **Location:** Munich, Germany and Boston, Massachussetts, USA **Client**: Monitor Corporation **Main project features**: Participated in two workshops as an energy expert to assist multi-national, multi-billion dollar corporations identify renewable and other energy technologies and to recommend appropriate approaches to develop and market these technologies **Positions held**: Consultant **Activities performed**: • Served as a technology expert/consultant in the "Future of Solar Cells" Workshop held in Munich, Germany to assist a multi-billion dollar international corporation to determine when and how best to enter the rapidly growing PV market. • Served as a expert/consultant in the "Alternate Energy" Workshop held in Boston, MA, USA which focused on the development and viability of three selected technology areas (BioButanol, Green Coal, Solar Cell), and the implications of that on Client's Renewable Energy Roadmap.

	Name of assignment or project: Renewable Energy and Energy Efficiency Systems for the Sheraton Hotel Tahiti and Proposed Takau Plaza **Year:** 2007 **Location:** Papeete and Bora Bora, French Polynesia **Client**: Sheraton Hotel Tahiti (through HSWAC) **Main project features**: Preliminary design of a portfolio of renewable energy and energy efficiency systems for a large hotel and proposed retail store complex in Tahiti, French Polynesia **Positions held**: Consultant **Activities performed**: • Conducted a site visit and walk-through energy audit to determine the energy requirements of this facility. • Identified various energy efficiency measures and renewable energy technologies that could provide all, or the majority of, energy requirements for this facility. • Prepared a preliminary feasibility analysis for a 1,200-ton seawater air conditioning (SWAC) system that could provide 100% of the air conditioning requirements of this facility. • Conducted a preliminary feasibility assessment of a 1.65-MW (gross)/1.04 MW (net) OTEC power plant to provide a portion of the electricity requirements of this facility. • Conducted a preliminary feasibility assessment of a 1.25 MW (DC)/1.03 MW (AC) PV system to provide a portion of the electricity requirements of this facility. • Conducted a preliminary assessment of a large-scale solar water heating system for this facility.

Name of assignment or project: Photovoltaic Project Experience

Year: 1976 - 2003

Location: Various locations in Hawaii, USA

Client: State of Hawaii – Department of Business; Economic Development, and Tourism – Energy Division; Hawaiian Sugar Planters' Association; University of Hawaii at Manoa

Main project features: Research, demonstration, development, and commercialization of photovoltaic systems

Positions held: Alternate Energy Specialist; Assistant Mechanical Engineer; Junior Researcher; Graduate Research Assistant

Activities performed related to Photovoltaic Projects:

- Comparative Technical and Economic Analyses of Two Candidate Companies (Energy Conversion Devices, Inc. and Chronar Corp.) for Special Purpose Revenue Bonds for the Construction of a PV Panel Manufacturing Facility in Hawaii. Due diligence, technical assessment, and economic assessment of two manufacturers of thin film (amorphous silicon) photovoltaic panels who had proposed to establish a PV manufacturing facility in Hawaii.

- Photovoltaics for Utility Scale Applications (PVUSA) - Hawaii Satellite Project (20 kW), Kihei, Maui, Hawaii. The state of Hawaii became involved with this nationwide program with the primary goals of assessing photovoltaic technologies in a utility setting and to transfer photovoltaic technology knowledge to the U.S. utilities. Served as the State of Hawaii's project manager for this project. The system consisted of 1,210 tandem-junction (two-layer) thin-film amorphous silicon modules (total area of 5,350 ft^2) interconnected to the utility via a line-commutated inverter with no storage facilities. The rated capacity of the system was 20 kW nominal [18.5 kW (DC)], but achieved a maximum power output of 21.3 kW (DC). The system produced power that was used by the island's electric utility. At the time, it was the largest operational PV system in the State. Also served as a member of the Photovoltaics for Utility Scale Applications (PVUSA) - Technical Review Committee.

- Photovoltaics for Utilities (PV4U) Working Group. Served as a member of the PV4U Working Group. PV4U was a loose confederation of State-level working groups that included universities, PV manufacturers, State energy offices, and utilities. The mission of this group was to speed the commercial adoption of PV through the utility sector.

- Electrical Energy by Means of Photovoltaic Power for the Hawaiian Fishing Village of Milolii on the South Kona Coast of the Island of Hawaii. State of Hawaii project manager for a project which installed 50 small (250 W_p), independent, off-grid PV systems on residences in the small fishing village of Milolii on the island of Hawaii. Each system incorporated an inverter and battery energy storage.

Activities performed related to Photovoltaic Projects (continued):

- Photovoltaic/Wind-Powered Electric Vehicle Charging Station and Utility-Intertied Energy Storage System. The intent of this project was to develop a utility-intertied hybrid photovoltaic- and wind-powered electric vehicle charging station that uses the electric vehicles' batteries for storage of surplus energy from these intermittent renewable technologies and has the capability to use off-peak power for charging and battery energy for on-peak use.

- Ka'ahele La (Tour of the Sun) Interscholastic Photovoltaic-Powered Vehicle Competition. State of Hawaii project manager/program coordinator for the Ka'ahele La solar car program. The Ka'ahele La solar car program asked teams of students, teachers and community members to design, construct and demonstrate full-scale photovoltaic-powered vehicles. Three secondary schools participated in the pilot program during the 1988-1989 school year. The Ka'ahele La program was expanded to include six schools in the 1989-1990 school year. These teams designed, constructed and demonstrated eight operational, full-scale photovoltaic-powered vehicles. It was believed to be the first, and only, program of its kind in the United States, at that time. The Ka'ahele La pilot program won the Grand Prize (First Place Overall - Best in All Categories) in the 1989 Best Energy Education Promotion (BEEP) competition, as determined by a vote of energy program managers from throughout the nation. The overall winning team and car the second year, from Konawaena, represented Hawaii in the World Solar Challenge, November 11-21, 1990. Konawaena was the first high school team to finish this 1,900-mile race from Darwin to Adelaide, Australia and finished 18th overall in a field of 36 competitors.

- Technical Advisor to the Kauai Community College Sunrayce Solar Car Team. Served, on behalf of the State of Hawaii, as a technical advisor to the Kauai Community College Sunrayce Solar Car Team. In spite of the fact that Kauai was struck by a hurricane during the development and incurred significant damage, the team was able to overcome these difficulties and finished 9th out of 34 teams during the 1993 Sunrayce. The team also finished 15th out of 36 teams in 1995.

- Technical Advisor to the Hawaii Electron Marathon Program. Served, on behalf of the State of Hawaii, as a technical advisor to the Hawaii Electron Marathon Program. This program asked teams of students, teachers and community members to design, construct and demonstrate small, single passenger, electric vehicles for demonstration and competitions. This program was patterned after Ka'ahele La solar car program, but involved conventional electric vehicles rather than solar cars, and was primarily funded by Hawaiian Electric Company (HECO).

	Activities performed related to Photovoltaic Projects (continued): **Energy Storage Project Experience:** • Significant experience and expertise in incorporating energy storage with photovoltaic systems to improve system utilization, to provide power during non-peak-solar periods, and to allow greater penetration of photovoltaic energy into the utility grid. Have conducted comparative technical and economic analyses of a variety of energy storage technologies (thermal, mechanical, and electrical) for use with a variety of intermittent renewable energy resources (wind, solar thermal, seawater air conditioning, photovoltaics, wave, and electric and hybrid vehicles). A variety of battery energy storage systems were evaluated for use with wind energy, photovoltaics, and electric and hybrid vehicles. These storage technologies were evaluated for both utility-intertied and stand-alone systems.

Name of assignment or project: Solar Thermal Project Experience

Year: 1976 - 2003

Location: Various locations in Hawaii, USA

Client: State of Hawaii – Department of Business; Economic Development, and Tourism – Energy Division; Hawaiian Sugar Planters' Association; University of Hawaii at Manoa

Main project features: Research, demonstration, development, and commercialization of solar thermal systems

Positions held: Alternate Energy Specialist; Assistant Mechanical Engineer; Junior Researcher; Graduate Research Assistant

Activities performed related to Solar Thermal Projects:

Concentrating Solar Thermal Systems

- Solar Electric Generating System (SEGS) Assessment for Hawaii. Project manager for a project to evaluate the potential of using solar electric generating systems in Hawaii. SEGS involve the use of concentrating, parabolic trough solar systems to generate electricity. The consultants employed in this project were directly involved in the large-scale (354-MW), commercial SEGS system in California. The SEGS power plants were built by Luz Industries, and commissioned between 1984 and 1991. This study looked at all of the characteristics that made these systems successful in California, and attempted to determine if similar characteristics were available in Hawaii.

- Critical Review and Analysis of the Hawaii County Economic Opportunity Council's (HCEOC) Concentrating (Fresnel Lens) Solar Thermal/PV System. This project involved an evaluation of a high temperature, concentrating solar system employing Fresnel lenses capable of achieving focal point temperatures in excess of 2,000^{o}F. Evaluation included an assessment of the ability of this organization to design, construct, operate, and maintain such a system, as well as an estimate of capital, O&M, and life cycle costs.

- Molokai General Hospital Solar-Powered Absorption Air Conditioning System. Project manager for a concentrating, parabolic trough solar system that was to provide both electricity (via a heat engine-electricity generator) and thermal heat (for absorption air water heating and other process heat applications) to Molokai General Hospital.

Activities performed related to Solar Thermal Projects (continued):

- Solar-Powered Absorption Air Conditioning and Hot Water Production Using the Barking Sands, Kauai, Hawaii Parabolic Trough Concentrating Solar System. Project manager for a project to evaluate the potential for converting to other uses a hybrid parabolic trough concentrating system that employed both PV and solar thermal components. This system used PV cells placed at the linear focal point of the parabolic troughs to generate electricity. PV cells were cooled by a heat transfer fluid which could be used for process heat, space cooling through absorption chillers, and potable water heating. Additional efforts were undertaken to improve the associated tracking system.

- Demonstration Solar-Powered Cogeneration System - Phases I and II. Prepared a proposal for design, construction, and demonstration of a concentrating, parabolic trough solar system that was to provide both electricity (via a heat engine-electricity generator) and thermal heat (for water heating and other process heat applications).

Other Solar Thermal Systems

- Development of a Solar Pond System Design Computer Model / Analysis of the Potential Applications and Methods of Improving the Performance of Solar Ponds. Ph.D. Dissertation. Evaluated the potential of combining medium temperature solar pond technology with ocean thermal energy conversion (OTEC). Use of a low temperature heat sink (deep, cold seawater) and a higher temperature heat source with integral energy storage (solar ponds) had the potential to significantly improve the performance (energy conversion efficiency) and cost effectiveness of the combined system relative to either of the other systems alone.

- Application of Heat pumps to Residential Water Heating (Evaluation of Solar Assisted Heat Pumps). M.S. Thesis. Evaluated the potential of augmenting heat pumps with solar thermal collectors. Also evaluated the benefits and cost of various thermal energy storage systems.

- Solar Resource Monitoring Program for Hawaii. Project manager for developing and conducting a solar resource (insolation) monitoring program for the State of Hawaii.

	Activities performed related to Solar Thermal Projects (continued): • Development and Application of a Computer-based Simulation Model for Solar Water Heating Systems to Predict Performance and Life-cycle Economics. Project manager for a project to develop a model for computer simulation of solar water heating systems. Evaluated system performance under a variety of parameters (insolation – daily and seasonal variations; collector orientations; etc.) Evaluated the life-cycle costs of such systems under varying economic parameters (financing methods; interest rates; lifetimes; etc.). • Transpired Solar Collectors for Agricultural Applications. Project manager for a project to evaluate the potential for transpired solar collectors for drying agricultural products and other low temperature agricultural applications. • Solar-Assisted Air Conditioning and Heat Pipe Dehumidification Demonstration Project. Project manager for a project to compare solar-assisted desiccant air conditioning with heat pipe-assisted air conditioning. • Demonstration of Solarized Fish Jerky Manufacturing and Marketing. Project manager for a project to evaluate the potential for solar drying of fish. Project also involved the evaluation of a business plan for a fish drying business. **Energy Storage Project Experience:** • Significant experience and expertise in incorporating energy storage with solar thermal systems to improve system utilization and to provide power during non-peak-solar hours and periods with reduced insolation. Have conducted comparative technical and economic analyses of a variety of energy storage technologies (thermal, mechanical, and electrical) for use with a variety of intermittent renewable energy resources (solar thermal, seawater air conditioning, photovoltaics, wind, wave, and electric and hybrid vehicles). These storage technologies were evaluated for both utility-intertied, as well as stand-alone systems.

	Name of assignment or project: Wind Project Experience **Year:** 1976 - 2003 **Location:** Various locations in Hawaii, USA **Client**: State of Hawaii – Department of Business; Economic Development, and Tourism – Energy Division; Hawaiian Sugar Planters' Association; University of Hawaii at Manoa **Main project features**: Research, demonstration, development, and commercialization of wind systems **Positions held**: Alternate Energy Specialist; Assistant Mechanical Engineer; Junior Researcher; Graduate Research Assistant **Activities performed related to Wind Projects**: • Hawaii Zuteck Rotor Project. Hawaii project manager for a project to design and build aileron retrofit blades for a Westinghouse 600 kW upwind, teetered rotor, full-span pitch control, horizontal-axis wind turbine. Fifteen of these 600-kW turbines were originally installed at Kahuku, Oahu, Hawaii along with the 3.2-MW MOD 5B wind turbine, the largest operating wind turbine in the world at that time. The primary purpose of this project was to improve the performance of similar wind turbines at lower wind speeds and in the turbulent wind conditions that are experienced in the Kahuku, Oahu area. • Establishment and Decommissioning of the State of Hawaii's Wind Resource Monitoring Network. Project manager for the establishment and decommissioning of a wind energy resource monitoring network for a number of sites in the State of Hawaii. Kahuku, Oahu was one of these monitoring sites. • Critical Review of Technical Data Concerning Natural Energy Corporation's (NEC) Venturi Rotor Wind Energy Converter (VR/WEC) and NEC's Business Development Plan. Due diligence, technology assessment, and economic assessment related to a new type of wind turbine that was proposed for development and siting in Hawaii. • Feasibility Study of Wind Farm Development in Hawaii - Consultant to ABAX Energy Services. This feasibility study involved design assistance, detailed economic and technical analyses, process evaluation, project evaluation and preliminary siting, reliability analysis, systems integration, and technology assessment of a new vertical axis wind turbine concept for wind farm development.

	Activities performed related to Wind Projects (continued): • Demonstration of a Pumped-Hydro Energy Storage System at the HNEI/Kahua Wind (Renewable) Energy Storage Test Facility. Kahua Ranch has had several wind projects, including one which used three 10 kW Bergey wind turbines, a 10 kW PV array, and a 30 kW diesel generator, in conjunction with a battery bank and pumped hydro system, to supply power to a greenhouse and 11 homes and shops on the ranch. This "village power" system was not connected to the electrical grid. Project manager for a small-scale wind-powered pumped-storage hydroelectric energy system. This project consisted of the three 10-kW Bergey wind turbines, a 25-kW (nominal) combined hydroelectric turbine/pump, a 6 million gallon upper reservoir, and a 1 million gallon lower reservoir. The purpose of this project was to evaluate the potential of storing intermittent wind energy and impacts of fluctuation of wind energy on power quality. Later renamed the Wind/Pumped-Hydro Integration and Test (WPHIT) Facility. • Molokai Wind/Diesel Electric Hybrid Demonstration Project. State of Hawaii project manager for a project to plan, design, engineer, permit, construct, operate, and maintain a wind/diesel hybrid system consisting of three 100 kW V17 Vestas wind turbines and 80-foot towers, a hybrid controller, anemometer station, and a 100 kW diesel generator and accessories. The purposes of this project were to: (1) examine the performance of the combination of commercially available wind turbines and a diesel electric generator for the potential of water pumping applications in Hawaii by simulating the dynamics of supplying required electricity to an actual water pumping system on Maui; (2) demonstrate the long-term reliability of wind/diesel hybrid operation; (3) develop an automatic, remotely dispatched and monitored wind/diesel system that will allow for an economically-feasible and technically-viable alternative for pumping water in Hawaii; and (4) examine the penetration effects of a wind/diesel power plant on a small utility, looking at penetration of off-peak utility demand and the effects of reactive power requirements. • Photovoltaic/Wind-Powered Electric Vehicle Charging Station and Utility-Intertied Energy Storage System. The intent of this project was to develop a utility-intertied hybrid photovoltaic- and wind-powered electric vehicle charging station that uses the electric vehicles' batteries for storage of surplus energy from these intermittent renewable technologies and has the capability to use off-peak power for charging and battery energy for on-peak use. • Feasibility Study for a Wind-Powered 1,500-kW Hydrogen Fuel Cell. The intent of this project was to evaluate the potential for converting excess wind energy to hydrogen and subsequent use of this hydrogen in a fuel cell.

	Activities performed related to Wind Projects (continued): • Wind Energy Use for Irrigation Pumping - A Preliminary Engineering Evaluation. Project manager for a project to evaluate the direct (mechanical) and indirect (electricity) use of wind energy for water pumping for the sugar industry in the State of Hawaii. • Corrosion Assessment of the Molokai Wind/Diesel Electric Hybrid System. This project was intended to evaluate the effect of corrosion on wind turbines located in the warm, humid, salt-laden atmosphere. **Energy Storage Project Experience:** • Significant experience and expertise in incorporating energy storage with wind systems to improve system utilization, to provide power during periods with low or no wind, to improve power quality, and to allow greater penetration of wind energy into the utility grid. Have conducted comparative technical and economic analyses of a variety of energy storage technologies (thermal, mechanical, and electrical) for use with a variety of intermittent renewable energy resources (wind, solar thermal, seawater air conditioning, photovoltaics, wave, and electric and hybrid vehicles). A variety of battery energy storage systems were evaluated for use with wind energy, photovoltaics, and electric and hybrid vehicles. These storage technologies were evaluated for both utility-intertied and stand-alone systems.

Name of assignment or project: Alternative Fuels and Biomass Project Experience

Year: 1976 - 2003

Location: Various locations in Hawaii, USA

Client: State of Hawaii – Department of Business; Economic Development, and Tourism – Energy Division; Hawaiian Sugar Planters' Association; University of Hawaii at Manoa

Main project features: Research, demonstration, development, and commercialization of alternative fuels and biomass

Positions held: Alternate Energy Specialist; Assistant Mechanical Engineer; Junior Researcher; Graduate Research Assistant

Activities performed related to Alternative Fuels and Biomass Projects:

Alternative Fuels

- Alcohol Transportation Fuels Demonstration Program. State of Hawaii project to evaluate the use of methanol, and other alcohol fuels, in flexibly-fueled State-owned vehicles. Included the design and construction of a methanol storage and dispensing facility.

- Assessment of the Technical and Economic Potential for Hydrogen Production With OTEC Electricity and Desalinated Water. State of Hawaii project manager for this project which evaluated the production of hydrogen from ocean thermal energy conversion (OTEC) as an energy storage/energy carrier.

- Demonstration of a Cost-effective Digester Gas Utilization System, Consisting of a Generator to Produce Electricity from Digester Gas, at the Kailua Municipal Wastewater Treatment Plant. The intent of this project was to produce digester gas through anaerobic digestion of sewage and to subsequently to use the digester gas in a generator to produce a portion of the electricity required by the wastewater treatment plant.

- Demonstration of the Effective Utilization of Biogas Produced by Anaerobic Digestion of Animal Wastes at Happy Hula Hog Farm and M&H Kaneshiro Farm. State of Hawaii project manager for a project to produce biogas through anaerobic digestion of pig manure to provide electricity for a pig farm and to provide additional treatment for pig wastes.

- Economic Analysis of the Substitution of Coal for Bagasse in Plantation Boilers and Alternative Uses of the Resulting Surplus Bagasse. Project manager for a project to determine the economic feasibility of substituting coal for bagasse (the waste biomass from sugarcane processing) in sugar industry boilers. This project also identified other, potentially higher-value, alternative uses of bagasse.

Activities performed related to Alternative Fuels and Biomass Projects (continued):

- Evaluate the Potential of Biogas Production and Waste Treatment Via Anaerobic Digestion of Stillage (a By-product of Ethanol Production). Project manager for a project to evaluate the potential for converting stillage into biogas via anaerobic digestion.

- Feasibility Study for a Wind-Powered 1,500-kW Hydrogen Fuel Cell. The intent of this project was to evaluate the potential for converting excess wind energy to hydrogen and subsequent use of this hydrogen in a fuel cell.

- Hawaii Ethanol From Molasses Program. Literature search team leader for a project to evaluate the potential for, and cost of, converting molasses from the sugar industry to ethanol.

- Preliminary Evaluation and Feasibility Study of the Production of Gaseous, Liquid, and Solid Fuels and By-products from Sugar Industry Biomass Feedstocks. Project manager for a study to evaluate the potential for converting sugarcane to various gaseous, liquid, and solid fuels and other by-products.

- Production of Methane Utilizing Anaerobic Treatment of Sugar Industry Wastewater. Project manager for a project to treat sugar factory wastewater by anaerobic digestion to produce biogas and other byproducts. Sugarcane washing and factory processes produce a large volume of wastewater with a high biochemical oxygen demand. This project attempted to improve the quality of this wastewater while generating useful and valuable fuel.

Biomass

- Evaluation of Biomass Handling and Drying Processes. Project manager for a project to evaluate the technical and economic feasibility of drying bagasse to improve boiler efficiency and to collect additional biomass from the field. Bagasse typically has moisture levels in the range of 45 - 50%. Reducing this moisture level by 10 to 15 points improves combustibility and combustion efficiency and reduces particulate and carbon monoxide emissions. Harvesting methods in Hawaii leave a significant amount of leafy trash in the field. This project also attempted to explore ways to recover more of this trash as a biomass fuel.

- Evaluation of the Effects of Bagasse/Biomass Dryers on Combustion Efficiency and Particulate Emissions. Project manager for a project to determine the optimum moisture content of bagasse based on an evaluation of the energy balance and cost of various bagasse drying methods. Stack gas emissions testing was also conducted to determine particulate and carbon monoxide emissions at various bagasse moisture levels.

Activities performed related to Alternative Fuels and Biomass Projects (continued):

- Heat Pumps for Drying Agricultural Products and Producing Process Heat. Project manager for a project to evaluate the technical and economic feasibility of using heat pumps to dry various agricultural products and for producing process heat.

- Preliminary Evaluation of an Alternative to Field Burning of Leafy Sugar Cane Biomass (Trash). Project manager for a project to evaluate various alternatives to field burning of leafy trash so that a greater fraction of this leafy trash could be used as a fuel.

Electric and Hybrid Vehicles

- 1991 Electric Vehicle Workshop. Organized and conducted an electric vehicle workshop to provide information on the status of the technology and benefits of electric vehicles.

- 1993 Pali Challenge - An Electric Vehicle Road Rally and Exhibition. Organized and conducted an electric vehicle road rally where six electric/hybrid vehicles crossed the Koolau Mountain Range on Oahu to demonstrate that such vehicles were capable of such trips and to determine energy efficiency.

- Electric Vehicle Association of Hawaii (EVAH). Founded this organization to promote electric vehicles and served as its president for five years.

- Ka'ahele La (Tour of the Sun) Interscholastic Photovoltaic-Powered Vehicle Competition. State of Hawaii project manager/program coordinator for the Ka'ahele La solar car program. The Ka'ahele La solar car program asked teams of students, teachers and community members to design, construct and demonstrate full-scale photovoltaic-powered vehicles. Three secondary schools participated in the pilot program during the 1988-1989 school year. The Ka'ahele La program was expanded to include six schools in the 1989-1990 school year. These teams designed, constructed and demonstrated eight operational, full-scale photovoltaic-powered vehicles. It was believed to be the first, and only, program of its kind in the United States, at that time. The Ka'ahele La pilot program won the Grand Prize (First Place Overall - Best in All Categories) in the 1989 Best Energy Education Promotion (BEEP) competition, as determined by a vote of energy program managers from throughout the nation. The overall winning team and car the second year, from Konawaena, represented Hawaii in the World Solar Challenge, November 11-21, 1990. Konawaena was the first high school team to finish this 1,900-mile race from Darwin to Adelaide, Australia and finished 18th overall in a field of 36 competitors.

	Activities performed related to Alternative Fuels and Biomass Projects (continued): • Operational Testing of Electric Vehicles. Conducted operational testing of a variety of electric vehicles over a number of years. • Photovoltaic/Wind-Powered Electric Vehicle Charging Station and Utility-Intertied Energy Storage System. The intent of this project was to develop a utility-intertied hybrid photovoltaic- and wind-powered electric vehicle charging station that uses the electric vehicles' batteries for storage of surplus energy from these intermittent renewable technologies and has the capability to use off-peak power for charging and battery energy for on-peak use. • Preliminary Analysis of the Effects on Electric Power Supply and Distribution Systems of the Introduction of Large Numbers of Electric Vehicles in Hawaii and the Benefits of Load Shifting and Time-of-Day Electric Rates. Conducted a preliminary assessment of various levels of electric vehicle penetration into the transportation mix, relative energy efficiencies of electric vehicles and conventional vehicles, and total energy use and energy impact on the electric utilities' generation and transmission and distribution systems. • Technical Advisor to the Hawaii Electron Marathon Program. Served, on behalf of the State of Hawaii, as a technical advisor to the Hawaii Electron Marathon Program. This program asked teams of students, teachers and community members to design, construct and demonstrate small, single passenger, electric vehicles for demonstration and competitions. This program was patterned after Ka'ahele La solar car program, but involved conventional electric vehicles rather than solar cars, and was primarily funded by Hawaiian Electric Company (HECO). • Technical Advisor to the Kauai Community College Sunrayce Solar Car Team. Served, on behalf of the State of Hawaii, as a technical advisor to the Kauai Community College Sunrayce Solar Car Team. In spite of the fact that Kauai was struck by a hurricane during the development and incurring significant damage, the team was able to overcome these difficulties and finished 9th out of 34 teams during the 1993 Sunrayce. The team also finished 15th out of 36 teams in 1996.

	Name of assignment or project: Seawater Air Conditioning (SWAC) Project Experience **Year:** 1976 - 2003 **Location:** Various locations in Hawaii, USA **Client**: State of Hawaii – Department of Business; Economic Development, and Tourism – Energy Division; Hawaiian Sugar Planters' Association; University of Hawaii at Manoa **Main project features**: Research, demonstration, development, and commercialization of SWAC **Positions held**: Alternate Energy Specialist; Assistant Mechanical Engineer; Junior Researcher; Graduate Research Assistant **Activities performed related to SWAC Projects**: • Innovative Energy Systems Workshop • Integration of Energy Storage With Seawater Air Conditioning (SWAC) Systems • Potential and Benefits for District Cooling Using Seawater Air Conditioning (SWAC) Integrated with Thermal Energy Storage (TES) • Potential Applications of Seawater Air Conditioning (SWAC) in Hawaii • Preliminary Statewide Assessment of Seawater Air Conditioning for Hawaii - Phase 1: West Beach, Oahu, Hawaii • Sea Water Air Conditioning (SWAC) Atlas for Hawaii • Sea Water District Cooling Feasibility Analysis for the State of Hawaii • Sea Water District Cooling Feasibility Analysis for the State of Hawaii – Preliminary Results

	Name of assignment or project: Ocean Thermal Energy Conversion (OTEC) Project Experience **Year:** 1976 - 2003 **Location:** Various locations in Hawaii, USA **Client**: State of Hawaii – Department of Business; Economic Development, and Tourism – Energy Division; Hawaiian Sugar Planters' Association; University of Hawaii at Manoa **Main project features**: Research, demonstration, development, and commercialization of OTEC **Positions held**: Alternate Energy Specialist; Assistant Mechanical Engineer; Junior Researcher; Graduate Research Assistant **Activities performed related to OTEC Projects**: • Applications of OTEC-Related Technologies in Hawaii • Assessment of the Technical and Economic Potential for Hydrogen Production With OTEC Electricity and Desalinated Water • Coupling Ocean Thermal Energy Conversion Technology With a Floating Nuclear Island • Demonstration OTEC Power Plant 'Demi-OTEC' for the Natural Energy Laboratory of Hawaii - A Concept Design and Economic Feasibility Study • Feasibility Analysis for Establishment of NELHA [Natural Energy Laboratory of Hawaii Authority]-Type Facilities at Other Locations in Hawaii • Feasibility Study for the Application of OTEC in Puerto Rico • Incentives for the Development of Ocean Thermal Energy Conversion in Oceania • NELHA-Type Facilities Project-Phase 2 • Ocean Thermal Energy Conversion Technology • Ocean Thermal Energy Conversion: A Review, Chapter II. OTEC Principle and Resource and Chapter III. Historic Development and Present Status of OTEC • Preliminary Design of a Kalina-Cycle OTEC Power Plant at the Proposed NELHA-Type Facility at Kekaha, Kauai, Hawaii • Preliminary Design of an NELHA-Type Facility at Kekaha, Kauai, Hawaii • State of Hawaii Request to Designate Hawaii (& U.S. Pacific Trust Territories) as a Specific Site for Favorable OTEC Property Tax Treatment • Systems Optimization for an Integrated Ocean Thermal Energy Conversion (OTEC) Plant

	Name of assignment or project: Wave Energy Project Experience **Year:** 1976 - 2003 **Location:** Various locations in Hawaii, USA **Client**: State of Hawaii – Department of Business; Economic Development, and Tourism – Energy Division; Hawaiian Sugar Planters' Association; University of Hawaii at Manoa **Main project features**: Research, demonstration, development, and commercialization of wave energy **Positions held**: Alternate Energy Specialist; Assistant Mechanical Engineer; Junior Researcher; Graduate Research Assistant **Activities performed related to Wave Energy Projects**: • ART OSPREY Hybrid Wind/Wave Energy System and Proposed Cost/Performance Study for Makapuu Point, Oahu, Hawaii • Feasibility of Developing Wave Power as a Renewable Energy Resource for Hawaii • Wave Energy Resource Assessment for the State of Hawaii
	Name of assignment or project: Hydroelectric Project Experience **Year:** 1976 - 2003 **Location:** Various locations in Hawaii, USA **Client**: State of Hawaii – Department of Business; Economic Development, and Tourism – Energy Division; Hawaiian Sugar Planters' Association; University of Hawaii at Manoa **Main project features**: Research, demonstration, development, and commercialization of hydroelectric **Positions held**: Alternate Energy Specialist; Assistant Mechanical Engineer; Junior Researcher; Graduate Research Assistant **Activities performed related to Hydroelectric Projects**: • Demonstration of a Pumped-Hydro Energy Storage System at the HNEI/Kahua Wind (Renewable) Energy Storage Test Facility • Small Hydroelectric Plant on Molokai Located in Central Molokai • U.S. Hydropower Resource Assessment for Hawaii • Wind-Powered Pumped-Storage Hydroelectric-Plus Program for the Island of Maui • Wind/Pumped-Hydro Integration and Test (WPHIT)

	Name of assignment or project: General Renewable Energy Project Experience **Year:** 1976 - 2003 **Location:** Various locations in Hawaii, USA **Client**: State of Hawaii – Department of Business; Economic Development, and Tourism – Energy Division; Hawaiian Sugar Planters' Association; University of Hawaii at Manoa **Main project features**: Research, demonstration, development, and commercialization of solar thermal **Positions held**: Alternate Energy Specialist; Assistant Mechanical Engineer; Junior Researcher; Graduate Research Assistant **Activities performed related to General Renewable Energy Projects**: • Alternate Energy Technologies System Modeling Contest (AETSMC) • Comprehensive Review and Evaluation of Hawaii's Renewable Energy Resource Assessments • Department of Hawaiian Home Lands Waiohuli (Maui) Project Task Force • Development of a Matrix of Permit Requirements for Various Renewable Energy Technologies as a Component of Permit Process Facilitation • Economic Analyses of Various Renewable Energy Incentive Programs • Energy and Environmental Summit (Energy: Supply-Side and Transportation Committees) • Energy Awareness Month Displays and Demonstrations • Energy Efficiency and Renewable Energy Use in the Hotel Industry – Two Case Studies (Hawaii and Sweden) • Enhancing Renewable Energy Development in Hawaii (EREDH) Workshop • Evaluation of Avoided Cost Components for Intermittent Renewable Energy Resources • Green Enertopia International Network (former Secretariat) • Prepared a manual for implementation of Act 77 - Relating to Energy Resources - Part II: Energy Efficiency in State Facilities (SB 2179, SD2, HD1, CD2 - Twenty-First Legislature, 2002, State of Hawaii) • Integrated Electric Utility Program • International Renewable Energy Conference (IREC) (Assist) • Natural Energy Laboratory of Hawaii Authority (NELHA) Strategic Planning Committee • Prepared and provided testimony in support of direct negotiations for State land leases for renewable energy projects

	Activities performed related to General Renewable Energy Projects (continued): • Prepared and provided testimony in support of legislation that requires the public utilities commission to develop and adopt a standard power purchase contract for the purchase of electricity by public utilities from non-fossil fuel producers • Renewable Energy for Sustainable Tourism • Renewable Energy Potential on Oahu • Renewable Energy Research, Development, Commercialization, and Export Promotion Plan for Hawaii • Renewable Energy Resource Assessment and Development Program • Renewable Energy Resource Supply Curves Computer Model • Technical and Economic Analyses of Proposed Renewable Energy Policy Initiatives • Technical and Economic Analyses of Various Integrated Resources Planning (IRP) Supply-Side Alternatives • The Energy Express - Mobile Energy Education Demonstration Trailer • The Natural Energy Laboratory of Hawaii Renewable Energy Systems Project • Uila Kupono I Hawai'i (Natural Energy in Hawaii) Videotape (Assist) • Utility Integration of Renewable Energy Resources • Utility Load Matching Computer Model

	Name of assignment or project: Global Climate Change / Greenhouse Gas Emissions Project Experience **Year:** 1976 - 2003 **Location:** Various locations in Hawaii, USA **Client**: State of Hawaii – Department of Business; Economic Development, and Tourism – Energy Division; Hawaiian Sugar Planters' Association; University of Hawaii at Manoa **Main project features**: Evaluate emissions of greenhouse gases and the impacts of these greenhouse gases on global climate change **Positions held**: Alternate Energy Specialist; Assistant Mechanical Engineer; Junior Researcher; Graduate Research Assistant **Activities performed related to Global Climate Change / Greenhouse Gas Emissions Projects**: • Drafted, prepared and presented testimony, and achieved passage of legislation to require the government of the State of Hawaii to significantly improve its energy management in state facilities in order to save taxpayer dollars and reduce emissions that contribute to air pollution and global climate change • Prepared and presented testimony, and helped achieved passage of legislation that establishes as state policy statewide greenhouse gas emissions limits at or below the statewide greenhouse gas emissions levels in 1990 to be achieved by January 1, 2020 and establishes greenhouse gas emissions reduction task force to prepare a work plan and regulatory scheme to achieve the statewide greenhouse gas emissions limits • Preparing an alternative (to HECO's) Integrated Resource Plan which provides for more aggressive renewable energy and demand side management development and which will allow HECO to meet State of Hawaii 2020 greenhouse gas emissions reduction requirements

Name of assignment or project: Energy Efficiency / Energy Conservation Project Experience

Year: 1976 - 2003

Location: Various locations in Hawaii, USA

Client: State of Hawaii – Department of Business; Economic Development, and Tourism – Energy Division; Hawaiian Sugar Planters' Association; University of Hawaii at Manoa

Main project features: Identification and implementation of energy efficiency and energy conservation measures

Positions held: Alternate Energy Specialist; Assistant Mechanical Engineer; Junior Researcher; Graduate Research Assistant

Activities performed related to Energy Efficiency / Energy Conservation Projects:

Cogeneration

- Analyze and Evaluate Large-scale Industrial Cogeneration Systems Used on Sugar Plantations to Produce Process Steam, Mechanical Power, and Electricity
- Demonstration Solar-Powered Cogeneration System - Phases I and II
- The Natural Energy Laboratory of Hawaii Renewable Energy Systems Project

Energy Audits

- Computerized Residential Energy Audits
- R. L. Cushing Building Energy Audit
- Sugar Industry Factory Energy Audits
- Sugar Industry Pump Test/Efficiency Program

Energy Conservation / Efficiency

- Drafted legislation, and prepared and presented testimony, which authorizes the issuance of $100 million in general obligation bonds for energy efficiency programs in state facilities (patterned after the "Vote Solar" initiative in San Francisco)
- Energy Efficiency and Renewable Energy Use in the Hotel Industry – Two Case Studies (Hawaii and Sweden)
- Home Energy Rating Systems (HERS) Workshops - "Financing and Selling Energy Efficient Homes in Hawaii"
- Innovative Energy Systems Workshop
- Integration of Energy Storage With Seawater Air Conditioning (SWAC) Systems
- Preliminary Statewide Assessment of Seawater Air Conditioning for Hawaii - Phase 1: West Beach, Oahu, Hawaii
- Prepared a manual for implementation of Act 77 - Relating to Energy Resources - Part II: Energy Efficiency in State Facilities (SB 2179, SD2, HD1, CD2 - Twenty-First Legislature, 2002, State of Hawaii)

	Activities performed related to Energy Efficiency / Energy Conservation Projects (continued): • Sea Water Air Conditioning (SWAC) Atlas for Hawaii • Sea Water District Cooling Feasibility Analysis for the State of Hawaii • Solar-Assisted Air Conditioning and Heat Pipe Dehumidification Demonstration Project • Sugar Industry Energy Conservation Guidebook • Sugar Industry Pump Test/Efficiency Program **Heat Pumps** • Application of Heat pumps to Residential Water Heating (Evaluation of Solar Assisted Heat Pumps) (M.S. Thesis) • Former member, Board of Directors, Essential Innovations • Heat Pumps for Drying Agricultural Products and Producing Process Heat
	Name of assignment or project: Energy Storage Project Experience **Year:** 1976 - 2003 **Location:** Various locations in Hawaii, USA **Client**: State of Hawaii – Department of Business; Economic Development, and Tourism – Energy Division; Hawaiian Sugar Planters' Association; University of Hawaii at Manoa **Main project features**: Research, demonstration, development, and commercialization of energy storage systems **Positions held**: Alternate Energy Specialist; Assistant Mechanical Engineer; Junior Researcher; Graduate Research Assistant **Activities performed related to Energy Storage Projects**: • Assessment of the Technical and Economic Potential for Hydrogen Production With OTEC Electricity and Desalinated Water • Demonstration of a Pumped-Hydro Energy Storage System at the HNEI/Kahua Wind (Renewable) Energy Storage Test Facility • Feasibility Study for a Wind-Powered 1,500-kW Hydrogen Fuel Cell • Integration of Energy Storage With Seawater Air Conditioning (SWAC) Systems • Photovoltaic-Powered Electric Vehicle Charging Station and Utility-Intertied Energy Storage System • Potential and Benefits for District Cooling Using Seawater Air Conditioning (SWAC) Integrated with Thermal Energy Storage (TES) • Wind-Powered Pumped-Storage Hydroelectric-Plus Program for the Island of Maui • Wind/Pumped-Hydro Integration and Test (WPHIT)

	Name of assignment or project: Sustainable Development / Village Power Project Experience **Year:** 1976 - 2003 **Location:** Various locations in Hawaii, USA **Client**: State of Hawaii – Department of Business; Economic Development, and Tourism – Energy Division; Hawaiian Sugar Planters' Association; University of Hawaii at Manoa **Main project features**: Promotion of sustainable development and development of village power systems **Positions held**: Alternate Energy Specialist; Assistant Mechanical Engineer; Junior Researcher; Graduate Research Assistant **Activities performed related to Sustainable Development / Village Power Projects**: • Department of Hawaiian Home Lands Waiohuli (Maui) Project Task Force • Electrical Energy by Means of Photovoltaic Power for the Hawaiian Fishing Village of Milolii on the South Kona Coast of the Island of Hawaii • Energy Efficiency and Renewable Energy Use in the Hotel Industry – Two Case Studies (Hawaii and Sweden) • Energy-efficiency and Conservation in Hotels – Towards Sustainable Tourism • Green Enertopia International Network • Renewable Energy for Sustainable Tourism

Name of assignment or project: Environmental Assessment and Permitting Experience

Year: 1976 - 2003

Location: Various locations in Hawaii, USA

Client: State of Hawaii – Department of Business; Economic Development, and Tourism – Energy Division; Hawaiian Sugar Planters' Association; University of Hawaii at Manoa

Main project features: Environmental impacts assessment and permitting for renewable energy projects

Positions held: Alternate Energy Specialist; Assistant Mechanical Engineer; Junior Researcher; Graduate Research Assistant

Activities performed related to Environmental Projects and Permitting:

General

- Air pollution monitoring and control
- Bachelor of Science Degree in Environmental Technologies and Urban Systems (emphasis on water quality)
- Completed extensive undergraduate- and graduate-level coursework in environmental sciences and engineering, including waste water analysis and treatment and environmental impact assessment and analysis
- Review and comment on Environmental Impact Assessments

Air Quality

- Attended and successfully completed (3 Continuing Education Credits were given for each course) the following courses at the Environmental Protection Agency's Air Pollution Training Institute in Research Triangle Park, North Carolina. Course 450 - Source Sampling Particulate Pollutants - January 26-30, 1981 and Course 468 - Source Sampling and Analysis of Gaseous Pollutants - February 2-5, 1981
- Attended and successfully completed the State of Hawaii - Department of Health - Pollution Investigation and Enforcement Branch - Visual Emissions Evaluations Course ("Smoke School") - March 16-18, 1981. Qualified observer (opacity reader) in accordance with requirements set forth in Method 9 - Visual Determination of the Opacity of Emissions from Stationary Sources. Periodic recertification (every 5-6 months) is required
- Boiler Emissions Source Test for The Lihue Plantation Company, Ltd., Bagasse Boiler Stacks - Lihue, Kauai, Hawaii, April 26-28, 1982 by OMNI Environmental Services, Inc.
- Calibration of Stack Sampling Equipment
- Design, Construct, Calibrate and Test a Low-cost, Light-weight, Simple-to-use, Portable, Isokinetic Stack Gas Particulate Sampling System

	Activities performed related to Environmental Projects and Permitting (continued): • Determination of Stack Gas Velocity, Volumetric Flow Rates, and Composition for The Lihue Plantation Company, Ltd., Bagasse Boiler Stacks - Lihue, Kauai, Hawaii, April 30, 1981 • Determination of Stack Gas Velocity, Vorticity, Volumetric Flow Rates, and Composition for The Lihue Plantation Company, Ltd., Bagasse Boiler Stacks - Lihue, Kauai, Hawaii, July 14, 1981 • Evaluation of the Effects of Bagasse/Biomass Dryers on Combustion Efficiency and Particulate Emissions • Final Performance Source Emissions Survey of Davies Hamakua Sugar Company - Haina Mill Bagasse Boiler and Drier Stacks - Haina, Hawaii, May 18-21, 1981 • Final Performance Source Emissions Survey of Hawaiian Commercial and Sugar Company - Paia Mill Bagasse Boiler Stack - Paia, Maui, Hawaii, May 24-26, 1982 • Final Performance Source Emissions Survey of Mac Farms of Hawaii, Inc., Macadamia Nut Shell Boiler Stack - Captain Cook, Hawaii, conducted March 2-4, 1982 • Final Performance Source Emissions Survey of Molokai Electric Corporation Biomass Boiler Stack - Palaau, Molokai, Hawaii, July 14-16, 1982 • Performance Test For Particulate Matter Emissions From Waipahu Municipal Incinerator Stacks 1/Ewa and 2/Honolulu - Waipahu, Oahu, Hawaii, February 14, 1983 • Preliminary Evaluation of an Alternative to Field Burning of Leafy Sugar Cane Biomass (Trash) • Preliminary Source Emissions Survey of Davies Hamakua Sugar Company - Haina Mill Bagasse Boiler and Drier Stacks - Haina, Hawaii, April 21-24, 1981 • Preliminary Source Emissions Survey of Hilo Coast Processing Company - Pepeekeo Mill Bagasse Boiler and Drier Stacks - Pepeekeo, Hawaii, September 16-18, 1981 • Source Emissions Survey of Ka'u Sugar Mill Company, Inc., Bagasse Boiler Stack - Pahala, Hawaii, August 24-25, 1981 • Source Emissions Survey of Olokele Sugar Company, Ltd., Mill Bagasse Boiler Stack - Kaumakani, Kauai, Hawaii, September 9-11, 1981 • Stack Emissions Skirmish Test of The Lihue Plantation Company, Ltd., Bagasse Boiler Stack - Lihue, Kauai, Hawaii, conducted March 26-27, 1981 • Stack Gas and Particulate Emissions Testing for Biomass- and Coal-Fired Boilers, Various • Stack Gas Vorticity and Velocity Determination for The Lihue Plantation Company, Ltd., Number 2 Scrubber - Lihue, Kauai, Hawaii, December 2, 1981 • Waialua Sugar Company, Inc., Bagasse Drier Evaluation Study - Waialua, Oahu, Hawaii, June 1981

	Activities performed related to Environmental Projects and Permitting (continued): **Water Quality** • Bachelor of Science Degree in Environmental Technologies and Urban Systems (emphasis on water quality) • Demonstration of a Cost-effective Digester Gas Utilization System, Consisting of a Generator to Produce Electricity from Digester Gas, at the Kailua Municipal Wastewater Treatment Plant • Evaluate the Potential of Biogas Production and Waste Treatment Via Anaerobic Digestion of Stillage (a By-product of Ethanol Production) • Production of Methane Utilizing Anaerobic Treatment of Sugar Industry Wastewater

Name of assignment or project: **Legislative- and Public Utilities Commission (PUC)-Related Experience**

Year: 1976 - 2003

Location: Various locations in Hawaii, USA

Client: State of Hawaii – Department of Business; Economic Development, and Tourism – Energy Division; Hawaiian Sugar Planters' Association; University of Hawaii at Manoa

Main project features: Drafted, prepared and presented testimony, and achieved passage of legislation and participated in a number of PUC-related activities to help promote various energy technologies

Positions held: Alternate Energy Specialist; Assistant Mechanical Engineer; Junior Researcher; Graduate Research Assistant

Activities performed related to Legislation- and the Public Utilities Commission (PUC):

- Drafted legislation, and prepared and presented testimony, which authorizes the issuance of $100 million in general obligation bonds for energy efficiency programs in state facilities (patterned after the "Vote Solar" initiative in San Francisco)
- Drafted, prepared and presented testimony, and achieved passage of legislation to allow enclosed, three-wheeled electric vehicles to be exempt from regulations that required motorcycle helmets and passengers to be over 18 years of age
- Drafted, prepared and presented testimony, and achieved passage of legislation that provided for free parking for electric vehicles in State and county controlled parking, free registration, special electric vehicle license plates, and use of HOV lanes at any time
- Drafted, prepared and presented testimony, and achieved passage of legislation to require the government of the State of Hawaii to significantly improve its energy management in state facilities in order to save taxpayer dollars and reduce emissions that contribute to air pollution and global climate change
- Participated in numerous Integrated Resources Planning and energy planning processes
- Prepared and provided testimony in support of direct negotiations for State land leases for renewable energy projects
- Prepared and provided testimony in support of legislation that requires the public utilities commission to develop and adopt a standard power purchase contract for the purchase of electricity by public utilities from non-fossil fuel producers
- Prepared and provided testimony in support of net energy metering for Hawaii
- Prepared and provided testimony in support of State income tax credits for solar thermal, photovoltaic, and wind energy systems
- Prepared and provided testimony on legislation in support of neighborhood electric vehicles
- Represented the Hawaii Solar Energy Association (HSEA) in Hawaii PUC, Docket No. 00-0209 and this assistance was instrumental in obtaining a higher rebate for solar water heating systems

Name of assignment or project: **Community Outreach and Education Project Experience**

Year: 1976 - 2003

Location: Various locations in Hawaii, USA

Client: State of Hawaii – Department of Business; Economic Development, and Tourism – Energy Division; Hawaiian Sugar Planters' Association; University of Hawaii at Manoa

Main project features: Provide energy and environmental education and develop community outreach programs

Positions held: Alternate Energy Specialist; Assistant Mechanical Engineer; Junior Researcher; Graduate Research Assistant

Activities performed related to Community Outreach and Education:

- Affiliate Grad Faculty, Department of Ocean and Resources Engineering, SOEST, University of Hawaii at Manoa
- Alternate Energy Technologies System Modeling Contest (AETSMC)
- Developed community outreach programs
- Developing an Integrated Suite of Energy- and Environmentally-Related Distance Learning Courses
- Earth Day Displays and Demonstrations
- Energy and Environment Course, Sustainable Energy Engineering International Master of Science Program, School of Mechanical and Materials Science, Swedish Royal Institute of Technology, Stockholm, Sweden - Delivered three lectures (Electric Vehicle Technology, Principles of Sustainable Development, and Energy Conservation Technologies), Spring 1999
- Energy and Environmental Summit
- Energy Awareness Month Displays and Demonstrations
- Hawaii State Science and Engineering Fair, Junior Display Division, Chief Judge
- Ka'ahele La (Tour of the Sun) Interscholastic Photovoltaic-Powered Vehicle Competition - Pilot Program
- Ka'ahele La (Tour of the Sun) Interscholastic Photovoltaic-Powered Vehicle Competition - Year 2
- Ocean Engineering Design Courses - ORE 783, Department of Ocean and Resources, SOEST, UHM (Spring 2009 "Preliminary Design of a Cooling Station, Seawater Pipe System, and Chilled Water Distribution System for an Up to 20,000-ton Seawater Air Conditioning (SWAC) District Cooling System for Pearl Harbor/Hickam/Honolulu International Airport;" Spring 2005 – "Preliminary Design of a Cooling Facility and Seawater Pipe System for the 20,000-ton (nominal) Downtown Honolulu Seawater Air Conditioning District Cooling System;" Spring 2002 - "Preliminary Design of a Kalina-Cycle OTEC Power Plant at the Proposed Kauai Ocean Resources, Inc. Ocean Science and Technology Park (KOROSTP) at Kekaha, Kauai, Hawaii;" and Fall 2000 - "Preliminary Design of an NELHA-Type Facility at Kekaha, Kauai, Hawaii")

	Activities performed related to Community Outreach and Education (continued): • Participated in the 1990 World Solar Challenge, a 1,900-mile solar car race from Darwin to Adelaide, Australia. Led a team of high school students to become the first high school team to finish this race. Finished 18th out of 36 teams • Renewable/Alternative Technologies Course, Sustainable Energy Engineering International Master of Science Program, School of Mechanical and Materials Science, Swedish Royal Institute of Technology, Stockholm, Sweden - Taught 4-credit course, Fall 1999 • Review and Selection Committee, Sterling Scholar Scholarship Program • Technical Advisor to the Hawaii Electron Marathon Program • Technical Advisor to the Kauai Community College Sunrayce Solar Car Team