CONSULTANT REPORT

PIER
Public Interest Energy Research
CALIFORNIA ENERGY COMMISSION

Buildings End-Use
Energy Efficiency

CIEE COLLABORATIVE PROGRAM PLANNING, MANAGEMENT AND TECHNOLOGY TRANSFER

Gray Davis, *Governor*

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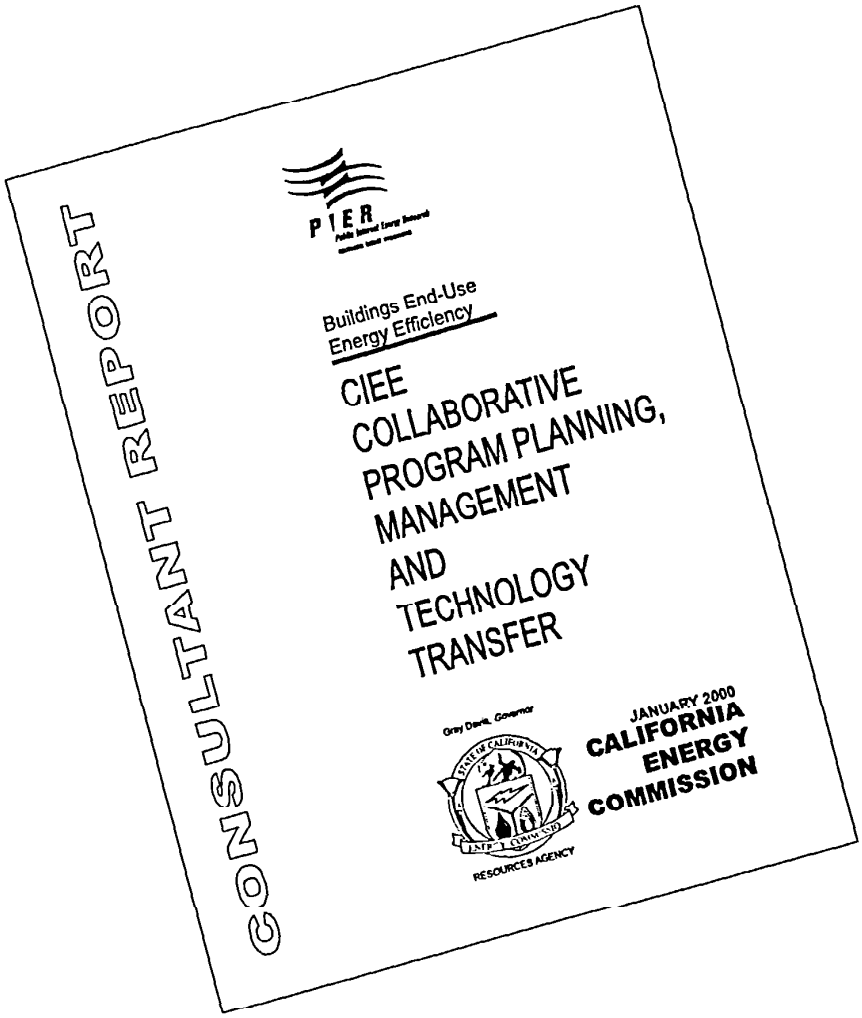

CALIFORNIA ENERGY COMMISSION

Prepared for:
CALIFORNIA ENERGY COMMISSION

Prepared by:
James Cole, *CIEE Director*

CALIFORNIA INSTITUTE FOR ENERGY EFFICIENCY

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Gary Klein, *Project Manager*
RESEARCH & DEVELOPMENT OFFICE

Nancy Deller, *Deputy Director*
ENERGY TECHNOLOGY DEVELOPMENT DIVISION

Gary Klein, *Contract Manager*
ENERGY TECHNOLOGY DEVELOPMENT DIVISION

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Acknowledgements

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Preface

The Public Interest Energy Research (PIER) Program supports public interest energy research and development that will help improve the quality of life in California by bringing environmentally safe, affordable, and reliable energy services and products to the marketplace.

The PIER Program, managed by the California Energy Commission (Commission), annually awards up to $62 million through the Year 2001 to conduct the most promising public interest energy research by partnering with Research, Development, and Demonstration (RD&D) organizations, including individuals, businesses, utilities, and public or private research institutions.

PIER funding efforts are focused on the following six RD&D program areas:

- Buildings End-Use Energy Efficiency
- Industrial / Agricultural / Water End-Use Energy Efficiency
- Renewable Energy
- Environmentally-Preferred Advanced Generation
- Energy-Related Environmental Research
- Strategic Energy Research.

In 1998, the Commission awarded approximately $17 million to 39 separate transition RD&D projects covering the five PIER subject areas. These projects were selected to preserve the benefits of the most promising ongoing public interest RD&D efforts conducted by investor-owned utilities prior to the onset of electricity restructuring.

What follows is the final report for the CIEE Collaborative Planning, Management and Technology Transfer project, one of nine projects conducted by the California Institute for Energy Efficiency. This project contributes to the Buildings End-Use Energy Efficiency, Industrial / Agricultural / Water End-Use Energy Efficiency and Energy-Related Environmental Research programs.

For more information on the PIER Program, please visit the Commission's Web site at: http://www.energy.ca.gov/research/index.html or contact the Commission's Publications Unit at 916-654-5200.

Executive Summary

Introduction

This report describes the work performed by the California Institute for Energy Efficiency (CIEE) between June 1998 and December 1999 on the Project 1: Collaborative Program Planning, Management and Technology Transfer component of the CIEE's Public Interest Energy Research (PIER) Transition Program funded by the California Energy Commission.

CIEE submitted a PIER Transition Program proposal to the CEC in October 1997 in response to the solicitation 500-97-501 and received notification of a $3,250,000 award in November 1997 for the 9 projects identified in Table 1. The University of California Office of the President (UCOP) and the Energy Commission negotiated the terms of the CIEE Transition Program contract that was approved by the Commission in May 1998.

Project 1 Objectives

The following summarizes the objectives of this Project 1 component of CIEE's PIER Transition Program:

(1) To manage the research and development of the new end-use efficiency technologies emphasized in Projects 2 through 9, using the effective collaborative program planning, funding and management practices (described in CIEE's Management Plan) established by the University of California in cooperation with the California Energy Commission, the California Public Utilities Commission (CPUC), California's major electric and gas utilities, and other CIEE sponsors over the past ten years;

(2) To coordinate with research teams involved in Projects 2 through 9 and the CIEE Research Board and other Sponsor representatives in exploring the initial market applications of these new energy efficiency technologies; this effort focused on the following technology transfer mechanisms: (a) the energy efficiency market transformation programs of California's utilities, EPA and DOE; (b) new building applications through the leadership of the California building industry and Title-24; (c) standards established by industry professional groups; (d) architectural, engineering and construction practices of industry leaders; and (e) patents, copyrights and the licensing of intellectual property;

(3) To conduct a third triennial review of its R&D program by an independent peer review panel in close consultation with the Energy Commission R&D Committee and the CIEE Research Board; and

(4) To plan and initiate the first phase of three new energy efficiency market transformation research and low NOx combustion R&D projects in close collaboration with the Energy Commission and other CIEE Sponsors; funding for these projects was provided by CIEE using Base Program funding provided by its utility Sponsors.

Table 1. CIEE PIER Transition Program

	PIER Transition Program Funding ($K)	CIEE Technical Liaison	CEC Project Manager	Lead Principal Investigator	Lead Institution
1. CIEE Collaborative Program Planning, Management and Technology Transfer	600K*	Cole	Klein	Cole	N/A
2. Residential Thermal Distribution Systems, Phase 7	400	Brown	Trenschel	Sherman	LBNL
3. Alternatives to Compressor Cooling, Phase 4	350	Brown	Reidel	Loisos	Loisos Architects
4. Commercial Thermal Distribution Systems, Phase 7	400	Brown	Shirakh	Modera	LBNL
5. Diagnostics for Commissioning & Operations, Phase 3	350	Blumstein	Wang	Piette	LBNL
6. Development & Demonstration of High Efficiency Lighting Torchieres, phase 2	90	Blumstein	Shirakh	Siminovitch	LBNL
7. Laboratories and Cleanrooms, Phase 4	375	Blumstein	Lowell	Sartor	UCI
8. Building Design Advisor, Phase 4	350	Blumstein	Cummins	Papamichael	LBNL
9. Formation of Nitrogen Oxides in Industrial Gas Burners and Stationary Gas Turbines, Phase 6	335	Cole	Layton	Samuelsen	UCI
TOTAL, CIEE Projects	**3,250**				

*CIEE Sponsors provide $125,000 in co-funding support for R&D Management during this 18-month program

Major Project Outcomes

The following are the principal outcomes of Project 1:

(1) Significant progress was made in developing the new end-use efficiency technologies considered in Projects 2 through 9; this progress is summarized in Section 2 of this report and described in more detail in the Final Report of each project. Summary level information about the development status of these CIEE technologies and their public interest R&D, economic and environmental benefits are available through CIEE's Website at http://www.ciee.ucop.edu/.

(2) CIEE coordinated with the R&D leaders of Projects 2 through 9 and several other recently-completed CIEE projects and with energy efficiency market transformation (EEMT) representatives of PG&E, SCE, SCG, SDG&E and SMUD in exploring initial market applications of these CIEE-developed technologies as part of the EEMT programs of these California utilities. Table 2 identifies 12 CIEE Supplemental projects with a total funding of $4.4 million that will be contracted by CIEE during the first quarter of 2000 with funding provided by PG&E and SCE in December of 1999. CIEE anticipates that additional market transformation applications of these and other CIEE-developed technologies will be funded by California's six largest electric and gas utilities (through CIEE) in cooperation with the Energy Commission, EPA, DOE and other market transformation entities in 2000 and 2001 as part of a statewide coordinated Emerging Technologies Initiative. CIEE recommended the establishment of this coordinated Initiative to the California Board for Energy Efficiency and the CPUC in June and July of 1999.

(3) CIEE coordinated with the R&D leaders of each Project team in exploring opportunities for continued funding of these R&D projects through the PIER General Solicitations and the Buildings Energy Efficiency Programmatic Solicitation. The R&D leaders of Projects 2, 3, 4, and 5 have been successful in obtaining PIER R&D funding support from the CEC for major components of these projects. CIEE and the Energy Commission representatives are currently exploring the possibility of continued funding of Project 7 during the initial stages of 2000.

(4) CIEE conducted an initial assessment of the potential public interest R&D benefits of continued funding of selected aspects of Projects 2 through 9. This assessment is contained in Section 2 of this report.

(5) CIEE collaborated with Energy Commission staff and CIEE Sponsor representatives in preparing and issuing a Request for Proposal (RFP) to select a research team and detailed research plan for the CIEE multiyear project: Market connections for New Commercial Building Technologies. A Proposal Evaluation Committee consisting of Energy Commission and other CIEE Sponsor representatives and stakeholders recommended the selection of the research team led by Nicole Biggart of UC Davis and Loren Lutzenhiser of Washington State University to conduct this project. This project was initiated in December 1999 with $340,000 in first phase funding provided by CIEE's utility Sponsors.

Table 2. CIEE Energy Efficiency Market Transformation Projects

Project Title	Funding ($000)	Sponsor
Residential HVAC	1,197	PG&E
Desktop Radiance	450	PG&E
Efficient Daylighting Systems for Commercial Buildings	165	PG&E
Daylighting Design	280	SCE
Commercial Building Facades	100	SCE
Commercial Commissioning & Diagnostics	176	PG&E
Controls & Commissioning Training	100	PG&E
Integrated Building Equipment Communications System- Market Assessment	165	PG&E
Program Planning & Coordination	75	PG&E
Workplace Productivity & Health	55	SCE
White Surfaces in Title 24	302	PG&E
High Technology Buildings	770	PG&E
Emerging Industrial Efficiency Technologies	82	PG&E
Total Funding (end of Dec 1999)	3,917	

(6) CIEE collaborated with Southern California Gas and other CIEE Sponsor representatives in planning and funding two public interest R&D projects involving the Low NOx, energy efficient combustion of natural gas in industrial, commercial and other market applications.

(7) CIEE coordinated with the Energy Commission R&D Committee in planning and conducting the third Triennial Review of CIEE and its R&D Program by an independent peer review panel in April of 1999. As summarized in Task 7 of Section 1 and described in its final report in Appendix VI, this CIEE Triennial Review Panel concluded that the overall quality of CIEE's R&D program was outstanding. The Panel concluded that "CIEE should have a continuing role in California's energy R&D future and that this role should be affiliate or adjunct to the CEC for the management of an appropriate portion of the PIER program, and not in the form of a subcontractor relationship." The Panel also concluded that "CIEE should work through its Research Board and the private sector electric utilities to manage a portion of the Energy Efficiency Market Transformation (EEMT) funds as well as continue to manage targeted research funds for other organizations. "CIEE should position itself to "tie" the CEC PIER efforts to the EEMT and other market place activities."

(8) The Energy Commission R&D Committee expressed interest in negotiating a Technical Assistance agreement with the University of California (UC) Office of the President (UCOP) for purposes of enabling the Commission to use CIEE and other scientific, technical, R&D program planning and management expertise at California's universities, colleges and national laboratories in the implementation of the PIER program. The Commission's Building End-Use Efficiency Program Manager and the CIEE Director have discussed an initial technical assistance work scope that both view as a conceptual starting point for collaboration in the planning and management of this PIER program area. Energy Commission and UCOP representatives are discussing the establishment of an interagency agreement for this and other related PIER purposes.

Conclusions and Recommendations

Although the Energy Commission is providing continued funding support of selected aspects of Projects 2, 3, 4, 5 and 7, CIEE believes that significant R&D benefits would be derived by California energy consumers from continued funding support for additional elements of Projects 2 through 9 as described further in Section 2. CIEE recommends that the Energy Commission consider funding this work as part of future phases of the PIER program.

CIEE plans to involve the Energy Commission staff and other Sponsor representatives in monitoring the progress of the energy efficiency market transformation projects listed in Table 2. CIEE anticipates that additional emerging technology projects may be identified, planned and funded by California utilities in cooperation with CIEE and the Energy Commission as of a coordinated statewide Emerging Technology Initiative that helps to bridge the PIER program with the energy efficiency market transformation programs of the California utilities.

As summarized previously, CIEE planned, funded and is managing the first phase of the Market Connections for New Commercial Building Technologies project and a related scoping study as part of this Transition Program using funding provided by California utilities in 1997. If the results of this first phase are promising, the Energy Commission should consider funding future phases of the public interest R&D aspects of these Market Transformation Research projects through the PIER program. CIEE will coordinate with its California utility Sponsor in funding related market transformation aspects of this project, possibly as part of a joint project with the Commission.

With funding support and strong encouragement from Southern California Gas, CIEE has been able to plan, fund and manage three multiyear research projects involving the Low NOx, energy efficient combustion of natural gas in industrial, commercial and other market applications. Without continuing funding from SCG and other California gas utilities, CIEE will not be able to continue to support these or other promising public interest R&D projects that offer the potential to yield significant energy efficiency, economic and environmental benefits for California's natural gas customers. CIEE recommends that the Energy Commission explore how it can collaborate with CIEE, its Sponsors and other stakeholders to sustain continued support of promising public interest R&D projects that benefit California's natural gas customers, including integration of these efforts with the PIER program.

CIEE and the Energy Commission staff were able to work together effectively with the leaders of each project team in the management of this PIER Transition Program. Through the use of

task-level deliverables, quarterly progress reports, Project Advisory Committee meetings and other periodic project review meetings, CIEE's project managers and the project team leaders enabled the Energy Commission project managers to make the key project management decisions associated with the conduct of each project, while delegating responsibility to the CIEE project manager to monitor project technical progress, review and approve invoices associated with the financial, and explore market transformation and other technology transfer opportunities with project team leaders. This approach fostered the effective use of limited Energy Commission project management resources.

CIEE effectively utilizes Project Advisory Committees (consisting of Energy Commission, other CIEE Sponsor, industry and other stakeholder representatives) to provide useful technical and market input in the conduct of each project and to explore initial market application of these technologies as part of California utility energy efficiency market transformation programs and the related voluntary new construction and Title-24 initiatives of the California Building Industry Association (CBIA), the Energy Commission and other stakeholders. CIEE would not be able to sustain the use of these Project Advisory Committee resources without the support of its Research Board.

Based on the productive experience of collaboration between CIEE and the Commission staff in the management of this Transition Program and the progress already achieved in linking this effort with the energy efficiency market transformation programs of PG&E and SCE, CIEE recommends that Energy Commission consider establishing an interagency agreement with UCOP during the first calendar quarter of 2000 that can effectively "tap" the full range of CIEE and UC capabilities as recommended in the final report of the CIEE Triennial Review Panel. The scope of this interagency agreement might include: (1) R&D program and project planning; (2) program and project management; (3) coordination and collaborative PIER and EEMT funding and contracting of interrelated R&D and market transformation projects; and (4) development of other technology transfer and collaborative funding opportunities.

Finally, one of the keys to CIEE's success (since its first year of full scale operation in 1990) has been its ability to collaborate with the Energy Commission and other Sponsors in the planning, funding and management of **innovative, leading-edge, multiyear public interest R&D projects**. These have normally been launched following scoping studies, planning workshops, industry and other stakeholder outreach efforts, followed by the development of a Request for Proposal that focuses on the relevant R&D issues and the involvement of stakeholders in the review and selection of the best proposal(s) for funding. Projects 2, 3, 4, 5, 7 and 9 and the new Market Connections project are specific examples of CIEE projects that were initially developed through this structured process. With the exception of the Market Connections project, CIEE has not been able to initiate any new innovative, leading-edge multiyear project through this process since 1994 because of uncertain prospects for continued Base Program funding from California utilities because of deregulation uncertainties. Although many of the Energy Efficiency and other projects funded by the PIER program have involved the further development of promising new energy technologies, very few if any promising innovative, leading-edge, new research opportunities are being pursued by the major PIER Energy Efficiency programs. Moreover, CIEE does not believe that the Energy Innovation Small Grant program is either the most effective or the only means that should be used to identify and develop new technologies and strategies for achieving the R&D goals and objectives described

in the Commission's PIER program plans. Consequently, based on its established track record, CIEE recommends that the Energy Commission collaborate with CIEE, its Sponsors and other stakeholders in planning, funding and managing at least 2 innovative, leading-edge Buildings and Industrial Energy Efficiency projects per year funded by PIER through a similar process.

Organization of the Final Report

The main body of the Project 1 final report consists of two sections.

Section 1 provides a summary of the work performed by CIEE on each major task. Section 2 summarizes CIEE's major conclusions about the R&D accomplishments of Projects of Projects 2 through 9, including its recommendations on desirable follow-on R&D and market transformation that are not currently being considered for funding by the PIER and California EEMT programs.

Abstract

This report describes the work performed by the California Institute for Energy Efficiency (CIEE) between June 1998 and December 1999 on the Collaborative Planning, Management and Technology Transfer component of Public Interest Energy Research (PIER) Transition Program funded by the California Energy Commission. Through this Project 1 effort, CIEE planned, funded and managed the efforts of the research teams involved in PIER Transition Projects 2 through 9 which focused on the research and development (R&D) of eight promising new end-use efficiency technologies. The results of these R&D efforts are described in separate Final Reports for each project. Through this Project 1 effort, CIEE collaborated with these research teams in exploring the initial application of these new technologies as part of the energy efficiency market transformation and new construction programs of its California utility, building industry and other Sponsors. This report summarizes CIEE accomplishments, conclusions and recommendations that resulted from the conduct of this Transition Program.

1.0 Summary of Work Performed by Major Task

1.1 Introduction and Project Objectives

The California Institute for Energy Efficiency (CIEE) is an organized research unit of the University of California (UC), administered by the UC Office of the President (UCOP). CIEE was established in 1988 and funded at an average annual level of $3.5 million over the 1990 through 1997 time period by California's six largest electric and gas utilities in cooperation with the California Public Utilities Commission (CPUC) and the California Energy Commission (Commission). The current CIEE Research Board is listed in Table 3. CIEE's mission established by its Research Board in 1989 is to collaboratively plan, fund and manage a State wide energy efficiency R&D program that would accomplish the following:

- Develop new knowledge and technologies that benefit California electric and natural gas consumers.
- Use of capabilities of California universities and laboratories.
- Involve Stakeholders' in planning the R&D agenda.
- Foster adoption by industry and public sector.

As illustrated in Table 4, this PIER Transition Program enabled CIEE to continue to pursue its mission and fund a significant portion of its R&D program energy in cooperation with California Energy Commission and the other CIEE sponsors in 1998 and 1999.

In Project 1 of its PIER Transition Program, CIEE conducted collaborative program planning, contracting, project management and technology transfer activities in support of Projects 2 through 9 listed in Table 1 and the other existing CIEE R&D projects listed in Table 5. The following summarizes the objectives of this Project 1 component of CIEE's PIER Transition Program:

1) To manage the research and development of the new end-use efficiency technologies emphasized in Projects 2 through 9, using the effective collaborative program planning, funding and management practices established by the University of California in cooperation with the California Energy Commission, the California Public Utilities Commission (CPUC), California's major electric and gas utilities, and other CIEE sponsors over the past ten years.

2) To coordinate with research teams involved in Projects 2 through 9, the CIEE Research Board and other Sponsor representatives in exploring the initial market applications of these new energy efficiency technologies; this effort focused on the following technology transfer mechanisms: (a) the energy efficiency market transformation programs of California's utilities, EPA and DOE; (b) new building applications through the leadership of the California building industry and Title-24; (c) standards established by industry professional groups; (d) architectural, engineering and construction practices of industry leaders; and (e) patents, copyrights and the licensing of intellectual property;

Table 3. Current CIEE Research Board

Sponsor	Research Board Member
California Energy Commission	Robert Pernell, Commissioner
California Public Utilities Commission	Henry Duque, Commissioner
University of California	Robert Shelton, Vice Provost for Research
Pacific Gas & Electric	Steven McCarty, Manager of Customer Energy Management
Southern California Edison	Gene Rodrigues, Director of Energy Efficiency Program
Southern California Gas	Mark Gaines, Director, Commercial & Industrial Marketing
Sacramento Municipal Utility District	Peter Keat, Member, SMUD Board of Directors
California Building Association	Robert Rivinius, Chief Executive Officer
National Association of Energy Service Companies	Terry Singer, Executive Director
U.S. Department of Energy	Art Rosenfeld, Advisor
Electric Power Research Institute	Clark Gellings, Vice President of Client Relations
Gas Research Institute	Ronald Edelstein, Strategic Planning Leader

Table 4. CIEE Program Budget Overview, CY 1998 and 1999
(Dollars in thousands)

Sources of CIEE Funding			**1998**	**1999**
Utilities: Base Program Dues (SCG and SMUD)			715	415
Energy Commission: PIER Program			3250	0
Utilities for Market Transformation Projects (see Table 2 for list)			0	3917
Carryover from Prior Year			610	986
Interest on Uncommitted Funds			184	60
Total Base Program Funding			4759	5378
Use of CIEE Funding				
Multiyear R&D Program				
	Residential Thermal Distribution	(PIER Project 2)	400	0
	Alternatives to Compressor Cooling	(PIER Project 3)	350	0
	Commercial Thermal Distribution	(PIER Project 4)	400	0
	Diagnostics- Bldg Commissioning	(PIER Project 5)	350	190
	Lighting Torchieres	(PIER Project 6)	90	0
	Laboratory-Type Facilities	(PIER Project 7)	375	0
	Building Design Advisor	(PIER Project 8)	350	0
	Low NOx in Industrial Gas Burners	(PIER Project 9)	335	220
	Market Connections Project	($390k in 1997 funding)	0	0
	Ultra Low NOx Premixed Burners		150	0
	Combustion of Methane in Oxygen Enriched Environment		150	0
	Subtotal, Multiyear R&D Program		2950	410
Exploratory Research Program			0	0
Opportunity Research Program			100	0
Collaborative Research Programs (see Table 5 for Project list)			60	0
Market Transformation Project Subcontracts (see Table 2 for list)			0	3487
Subtotal, R&D Subcontracts			3110	3897
R&D Program Management				
	CEC PIER Transition Program		139	461
	Utility Sponsor Funds for PIER Transition Program		120	0
	Utility Sponsor Funds for Other CIEE R&D Projects		404	170
	Subtotal, Program Management		663	631
Total Uses of CIEE Funding			3773	4528
Total Planned Carryover of Funding to Next Year			986	850
Planned Carryover for Program Management			0	750

Planned Carryover for Uncommitted R&D Purposes	986	100

Table 5. Other Active CIEE R&D Projects
Funded by CIEE Sponsors in 1997 and 1998

		Funding ($000)
New Multiyear Projects		
Market Connections for New Commercial Building Technologies		395
Ultra Low Emission Premixed Burners		150
Combustion of Methane in Oxygen Enriched Environment		150
	Subtotal	695
Opportunity Research/Scoping Studies		
Market Transformation Research		65
Fuel Cells in Buildings		20
	Subtotal	85
Opportunity Research/Collaborative R&D		
Center for Built Environment		30
National Fuel Cell Research Center		10
California Institute for Food and Agricultural Research		15
	Subtotal	55
Exploratory Research		
Compressorless House Optimization		60
Energy Efficient Water Systems		60
		120
	Total	955

3) To conduct a third triennial review of its R&D program by an independent peer review panel in close consultation with the Energy Commission R&D Committee and the CIEE Research Board; and

4) To plan and initiate the first phase of three new energy efficiency market transformation research and low NOx combustion R&D projects in close collaboration with the Energy Commission and other CIEE Sponsors; funding for these projects was provided by CIEE using Base Program funding provided by its utility Sponsors.

The following subsections summarize the work performed by CIEE staff on each major task of the Transition Program Contract. Major collaborative, program planning and management

activities conducted by CIEE staff that “bridge across” two or more tasks are highlighted in each applicable task.

1.2 Task 1.0: Revise Work Statement and Task Deliverables, Schedules, and Budgets, Exhibits A, B and C.

From the June through September 1998, CIEE focused on two interrelated activities: (1) managing the concluding stage of prior phases of Projects 2 through 9 listed in Table 1 (this included the preparation of Draft Final Reports by each project team) and; (2) coordinating with the lead Principal Investigator of each project team in making further refinements of the work statements (Exhibit A), Task Deliverables and Schedule (Exhibit B), and Budget (Exhibit C), based on the final results obtained in the concluding stage of each project. CIEE coordinated the process of soliciting comments from each Project Advisory Committee on these Draft Final Reports and project plans. CIEE subsequently requested Commission project managers approval of each project plans prior to subcontracting. [CIEE received official notification of the Commission approval of the final plans (i.e. Exhibits A, B and C) for project 1 through 9 in the form of a letter from Michael Smith, dated October 26, 1998.]

In June 1999, the California Energy Commission Contract Manager informed the CIEE Director that the Commission had scheduled a PIER “Energy Innovations ‘99” conference on October 25-27, 1999 and desired to facilitate the voluntary participation of CIEE lead principal investigators (PIs) in a poster session on October 25, 1999. In order to reimburse PIs for these conference-related travel costs, the CIEE Director and Commission Contract Manager concluded that the contractual deadline of Projects 2 through 9 should be extended for a minimum of one month (through November 1,1999).

The Commission Contract Manager also indicated that the California Energy Commission R&D Management Committee was willing to consider a limited 1 or 2 month additional no-cost, time extension for one or more specific projects, if CIEE could provide sufficient documentation to the Commission Contract Manager about the reasons for and benefits of each no-cost time extension. Based on its assessment, CIEE concluded that the quality of the R&D results for Projects 3, 7 and 9 would be significantly improved with a three-month time extension through December 31, 1999. The CIEE Director made this recommendation in written form with back-up justification to the Commission Contract Manager in the June 1999. The Commission Contract Manager informed the CIEE Director that these no-cost contract extensions would be approved following the submission of revised versions of Exhibit B for each project. A formal contract modification approving these no-cost time extensions was approved by the California Energy Commission on September 8, 1999.

1.3 Task 2.0 Prepare Quarterly Progress Reports

During the initial stages of this contract, CIEE coordinated with the California Energy Commission Contract Manager in establishing the Commission’s desired format for Quarterly Progress Reports, which described the work preformed, and financial expenditures during the prior calendar quarter. An example of a typical Quarterly Progress Report is provided in Appendix I.

CIEE submitted a Quarterly Progress Report on Project 1, including a package of updated Project Plans (i.e. Exhibits A, B and C) for Projects 1 through 9 in October 1998. CIEE submitted Quarterly Progress Reports for projects 1 through 9 to California Energy Commission project managers in January, April and August of 1999.

This Transition Contract authorized CIEE to submit Quarterly Advance Payment requests to the California Energy Commission Contracts Office requesting the amount of funds for Projects 1 through 9, necessary to perform the work of the next calendar quarter. The Commission requested that these Quarterly Advance Payments requests include reconciliation of the difference between estimated expenditures and actual expenditures incurred during the previous quarter. CIEE and Commission staff also coordinated closely during the initial stages of this contract in establishing the specific format and reconciliation methodology that would be use in preparing these Quarterly Advance Payment requests.

It was agreed that the Commission project managers would be responsible for reviewing and approving Commission payment of these Quarterly Advance Payment requests by the Commission Contract's Office, as part of the process of reviewing each Quarterly Progress Report. Appendix II provides a typical example of Quarterly Advance Payment Request for one selected budget. CIEE experienced several problems in the preparation of the reconciliation component of the Advance Payment request.

1.4 Task 3.0 Collaborative Program Planning and Funding

In July 1997,the CIEE Research Board authorized CIEE to submit a Transition Program proposal to the California Energy Commission and enter into this Transition Program contract to accomplish the near-term objectives highlighted in the Introduction. CIEE and its Research Board views this Transition Program within the context of its longer-term strategic objectives summarized in Section 2 and discussed in more detail in CIEE's Strategic Plan (Appendix III).

The following three subsections describe the collaborative program planning, funding and management activities conducted by CIEE in support of this Transition Program and other related R&D, emerging technology and market transformation initiatives. Table 4 summarizes the sources of CIEE funding in 1998 and 1999 and their commitment to PIER Transition Program and other complementary public interest R&D and market transformation projects.

1.5 Shift of CIEE's Operations from LBNL to UCOP

Although the Commission announced plans in November of 1997 to provide CIEE with $3,250,000 in PIER Transition Program Funding, CIEE and UCOP experienced extensive delays in negotiating mutually acceptable terms and conditions for an interagency agreement with the Commission. Because of uncertainty regarding the ultimate resolution of the underlying contract negotiation issues, the shift of CIEE's administrative operation and personnel from Lawrence Berkeley National Laboratory (LBNL) to UCOP could not be initiated until the contract was approved by the Commission, UCOP and the state Division of General Services. This was subsequently accomplished in early July of 1998. Because of the time required to address staffing and administrative changes, CIEE was not able to complete this administrative shift until October 1, 1999. During the July through September 1998 transition period, funding from its California utility sponsors were used to fund approximately $125,000 of CIEE's

program management costs at LBNL. This co-funding support enabled CIEE to conduct the activities described in Tasks 1, 2, 4 and 5 in an integrated manner, without any adverse schedule and other impacts on the project teams and the Commission. In March of 1999, CIEE completed a physical move of its office from LBNL to UCOP–based facilities in downtown Berkeley.

1.6 Collaborative R&D Planning and Project Funding

CIEE's efforts in this category focused on the following three activities:

1) CIEE encouraged the leaders of each project team to submit proposals in response to the PIER General Solicitations and the Building End-Use Efficiency Programmatic Solicitation. Selected aspects of Projects 2, 3 and 4 received funding commitments from the Energy Commission as an outcome of the Second General Solicitation. Selected aspects of Project 5 received a funding commitment from the Commission in response to the Programmatic Solicitation. CIEE is currently coordinating with the Commission Industrial Efficiency Program Manager regarding potential funding of selected aspects of Project 7 through an interagency agreement with UCOP on behalf of CIEE.

2) CIEE coordinated with SMUD and other CIEE Sponsor representatives and the lead PI of Project 5 in developing a plan for a second-generation demonstration of the Information Management and Diagnostic System in a commercial office building in Sacramento. As indicated in 1999 column of Table 4, CIEE plans to commit $190,000 in funding for this project and anticipates that it will commit an additional $115,000 in funding for this effort in 2000.

3) CIEE is coordinating with SCG and other CIEE Sponsor representatives and the lead PI of Project 9 in developing a plan for the next phase of this project that focuses on industrial burner and boiler applications of this technology. As indicated in the 1999 column of Table 4, CIEE is planning to commit $220,000 in funding for the next phase of this effort.

1.7 Emerging Technologies and Market Transformation

At the July 28, 1998 meeting of the CIEE Research Board, California Energy Commissioner Jananne Sharpless asked CIEE to consider the possibility that it could collaborate with its California utility sponsors and the Commission in serving as a "bridge" between the PIER program and the energy efficiency market transformation program of (EEMT) the California utilities. Commissioner Sharpless envisioned that this collaborative program could specifically focus on the initial market application of new CIEE and other PIER–developed technologies. Over the past 12–15 months, CIEE has been exploring the establishment of this PIER–EEMT Collaborative program with Nancy Jenkins, Scott Matthews, Sy Goldstone and other Commission staff representatives as well as with CIEE Research Board, Planning Committee and other stakeholder representatives. CIEE conceptualized an emerging technology initiative and presented the testimony in Appendix IV to the California Public Utilities Commission (CPUC) and the California Board for Energy Efficiency (CBEE). On November 16, 1999, CIEE presented similar comments regarding the establishment of this emerging technology initiative to the Commission as part a public workshop on its Draft AB1105 report to the Legislature.

During the third quarter of 1999, Nancy Jenkins requested that Karl Brown, CIEE Buildings Program Manager, prepare the Research Results and Market Transformation Strategies

summary contained in Tables 6 through 11 corresponding to both CIEE and PG&E Transition Program projects as part of the Commission's efforts to foster collaboration between PIER and EEMT programs. Ms. Jenkins distributed the first two columns of these Tables to California utility market transformation program leaders, for their consideration in planning the 2000 and 2001 market transformation program.

Table 6. Residential Thermal Distribution (Project 2)
Research Results and Market Transformation Strategies

CONTRACT INFORMATION	RESEARCH RESULT/AUDIENCE	MARKET PENETRATION STRATEGIES
Contract #: 500-97-013 Contractor: CIEE **Project Name**: Residential Thermal Distribution Systems **Contract Manager**: Ann Peterson/Dale Trenschel **Contract Term**: Sept. 30, 1999 **Contract Amt**: $400,000 **Project Description**: The purpose of this project is to develop knowledge and technology that will improve the energy-efficiency and performance of thermal distribution and associated system performance for heating, ventilation, and air-conditioning (HVAC) systems in residential buildings. This project assesses the performance of air-duct systems in California's residential buildings, develops test methods and other technology to diagnose thermal distribution problems, evaluates whole-system benefits of improved ducts, and transfers technical information to the various parts of the energy efficiency and building industry and to market transformation activities.	Product 1-Refined methods for measuring duct leakage ASHRAE 152 standard development committee, ASTM duct leakage test method development committee (intermediate); Building codes, HERS, Builders, HVAC contractors **Product 2**-Standardized test method for testing duct sealant longevity **Audience**-ASTM standard committee (intermediate), rating laboratories, Building codes, HERS, Builders, HVAC contractors **Product 3**-Quantification of impact of design and installation deficiencies (e.g. loose ducts, wrong refrigerant charge, etc.) on system cooling performance, evaluation of quality ducts and other design or installation improvements as methods to increase cooling capacity (instead of more equipment tonnage) **Audience**-Builders, HVAC contractors **Product 4** – Updated Report: "Improving the Energy Efficiency of Air Distribution Systems in New California Homes" **Audience** – Builders, HVAC contractors **Product 5** – Technical information for energy codes, HERS, ACCA manuals, Energy Star and Building America programs, STTR projects **Audience** – Building codes, HERS, Technology developers (intermediate); Builders, HVAC contractors, Home buyers, Manufacturers	**Industry Standards and Guidelines (ASTM, ASHRAE, ACCA) —** improvement of industry standards and guidelines is a strategy by itself as quality practitioners and the efficiency industry use these as a reference for defining good performance **Industry Labels**—through standards, guidelines and technical support; enable hardware ratings (e.g. UL) to certify more aspects of material and equipment performance (e.g. sealant longevity), enable Home Energy Rating Systems (HERS) to encourage and reward quality of duct construction; resulting in both energy-efficient mortgages and buyer perception of quality **Building Codes**—through standards, guidelines and technical support; enable energy and other codes to reward higher quality duct construction **Hardware**—through standards, guidelines and technical support to STTR, facilitate the development of improved duct hardware for commercialization by manufacturers **Training to builders, HVAC contractors**—through quantification of performance improvements and documentation "Improving the Energy Efficiency…" **National Market Transformation Programs**—enable Energy Star and Building America Programs with improved technical information regarding building components and systems **CA Market Transformation** Programs—enable programs through above strategies.

Table 7. Alternatives to Compressor Cooling (Project 3)
Research Results and Market Transformation Strategies

CONTRACT INFORMATION	RESEARCH RESULT/AUDIENCE	MARKET PENETRATION STRATEGIES
Contract #: 500-97-013 **Contractor:** CIEE **Project Name:** Alternative to Compressor Cooling **Contract Manager:** Randel Riedel **Contract Term:** Sept. 30, 1999 **Contract Amt:** $350,000 **Project Description:** The purpose of this project is to reduce the residential cooling electric load, improve load factors, reduce energy use, and reduce the costs of electricity supply associated with this load. The project seeks to create and promote house designs that provide summer comfort performance equivalent or better than typical current production housing, with minimal use of compressor-based cooling, with construction technology adaptable from current common practices, and in marketable design packages. House designs are enabled by development of improved cooling performance evaluation methods, prototype controls for low-energy cooling systems, and market transformation research.	**Product 1—**Prototype controls for low energy cooling systems **Audience—**Controls developers, home automation industry, market transformation program developers **Product 2—**Market Transformation Research Results: assessment of market penetration opportunities for summer comfort performance houses and low-energy cooling **Audience—**Market transformation program planners **Product 3—**Performance evaluation tools and applications information for summer comfort performance and low-energy cooling systems **Audience—**Architects, builders, developers market transformation program developers **Product 4—**New summer comfort performance low-energy cooling house designs suitable for Southern California and Northern CA markets **Audience**—Architects, builders, developers, home buyers, market transformation program developers **Product 5**—Planning for pilot project(s) intended to demonstrate improved house designs that provide summer performance with minimal compressor cooling, performance evaluation plan(s) **Audience**—Builders and developers, market transformation program planners	• **Pilot Developments or Houses—** demonstrate summer comfort and low-energy performance of improved houses through pilot projects • **Industry Awards**—encourage development of improved summer performance low-energy house designs through industry awards (e.g. Gold Nugget) • **Time-of-use Weighting in Building Codes—**couple performance evaluation and applications information with moves toward time-of-use weighting for energy codes • **CA Market Transformation Programs—**create low-energy cooling programs, enable programs through above strategies

Table 8. Commercial Thermal Distribution (Project 4)
Research Results and Market Transformation Strategies

CONTRACT INFORMATION	RESEARCH RESULT/AUDIENCE	MARKET PENETRATION STRATEGIES
Contract #: 500-97-013 **Contractor:** CIEE **Project Name:** Commercial Thermal Distribution Systems **Contract Manager:** Maziar Shirakh **Contract Term:** Sept. 30, 1999 **Contract Amt:** $400,000 **Project Description:** The purpose of this project is to provide new technology and applications knowledge that will allow the construction and energy services industry to reduce energy waste in commercial thermal distribution systems. This will be done through the accumulation of credible data on the actual field performance of duct systems, through development and implementation of aerosol technologies for duct sealing and insulation encapsulation, and through identifying system performance impacts of poor duct systems.	**Product 1**—Characterization and quantification of commercial building duct performance **Audience**—R&D planners, market transformation program developers, ASHRAE, building designers, building owners and operators, energy service companies, building codes, technology developers, SMACNA, HVAC contractors **Product 2**—Advancement and field testing of aerosol duct sealing technologies for large commercial building systems **Audience—**Technology commercializers, market transformation program developers, energy service companies **Product 3**—Development and testing of aerosol duct lining technologies for large commercial building systems **Audience—**Technology commercializers, duct manufacturers, indoor environmental service and energy service industries **Product 4**—Diagnostic and benchmarking protocols for fan systems in large buildings, web-based benchmarking database **Audience** – DOE2 based program developers **Product 5**—Preliminary quantification of system performance impacts of improved ducts in commercial buildings, through improved analysis methods for building simulation **Audience**—Building simulation program developers, Building codes, building designers	**Document Poor Duct Performance—** increase industry understanding of previously unrecognized performance problems through presentations and publications (e.g. ASHRAE) **Commercialization of Aerosol Sealing Technology** **Commercialization of Aerosol Duct Lining** Technology—with input from industry project advisors (e.g. Certainteed) **Third-Party Testing of Fan Diagnostic Protocols** **Fan Performance Benchmarking Database—**increase awareness and understanding of efficiency opportunities for large fan systems through web publication of fan performance information **Design/Analysis Tools**—enable developers to include duct performance parameters in building simulation tools **Industry Standards and Guidelines—** improved accounting for duct performance in standards (e.g. ASHRAE, SMACNA) **Industry** Labels—enhance commercial building rating systems **Building Codes—**enable energy and other codes to reward higher quality duct construction **University of California Facilities—**energy management input to UC via Enron's 33 campus UC/CSU contract **CA Market Transformation Programs—** create duct programs for commercial buildings, enable programs through above strategies

Table 9. Diagnostics for Building Commissioning and Operations (Project 5)
Research Results and Market Transformation Strategies

CONTRACT INFORMATION	RESEARCH RESULT/AUDIENCE	MARKET PENETRATION STRATEGIES
Contract #: 500-97-013 **Contractor:** CIEE **Project Name:** Diagnostics for Building Commissioning and Operations **Contract Manager:** Joseph Wang **Contract Term:** Sept. 30, 1999 **Contract Amt:** $350,000 **Project Description:** The purpose of this project is to demonstrate an advanced operator information monitoring and diagnostics system for whole-building commissioning and operations. This system will include high quality sensors, automated communications and data management, and data visualization to diagnose building energy performance problems. The project will also explore automated diagnostics and a knowledge base to identify system failure.	**Product 1—**Functional specification for cost-optimized Information, Monitoring, and Diagnostic System (IMDS) design for Class A Buildings **Audience** – Energy Service Companies (ESCOs), engineering firms, controls companies, property management firms **Product 2** – Cost-benefit analysis for enhanced diagnostic capability **Audience**— Energy Service Companies (ESCOs), engineering firms, controls companies, property management firms **Product 3—**Pilot IMDS site **Audience** - Energy Service Companies (ESCOs), engineering firms, controls companies, property management firms **Product 4—**Preliminary assessment of automated diagnostic enhancements to IMDS **Audience—** Controls companies, Technology developers	• **Building Operators—**create market pull from building operators, generated by peer group of technical leaders of large property management firms **Demonstrations—**document benefits of technology in Class A office buildings and other building types (e.g. university campuses, medical centers, large retail malls, research parks) **Specification Dissemination—** provide technology push with functional specification that defines minimum capabilities for an effective diagnostic system **CA Market Transformation Programs—**create programs for improved building controls, diagnostics, automation; including IMDS technology

Table 10. High Efficiency Lighting Torchieres (Project 6)
Research Results and Market Transformation Strategies

CONTRACT INFORMATION	RESEARCH RESULT/AUDIENCE	MARKET PENETRATION STRATEGIES
Contract #: 500-97-013 **Contractor:** CIEE **Project Name:** Development and Demonstration of High-Efficiency Lighting Torchieres **Contract Manager:** Maziar Shirakh **Contract Term:** Sept. 30, 1999 **Contract Amt:** $90,000 **Project Description:** The purpose of this project is to develop and test the first of a new generation of "torchiere" lighting fixtures using new energy-efficient, advanced (e.g. electrodeless) high-lumen output fluorescent lamps. The project will focus on applications in commercial office buildings.	**Product 1—**measured input and output characteristics of new lamp types **Audience—**Fixture manufacturers **Product 2 —**Hardware: prototype high output high efficiency compact fluorescent lamp and torchiere fixture. **Audience-**Lamp and fixture manufacturers	• **Demonstrations—**high visibility demonstrations similar to university dormitories for original CFL torchiere • **CA Market Transformation Programs—**create market transformation programs around high-performance fixture designs

Table 11. Building Design Advisor (Project 8)

Research Results and Market Transformation Strategies

CONTRACT INFORMATION	RESEARCH RESULT/AUDIENCE	MARKET PENETRATION STRATEGIES
Contract #: 500-97-013 **Contractor:** CIEE **Project Name:** Building Design Advisor **Contract Manager:** Tav Cummins **Contract Term:** Sept. 30, 1999 Contract Amt: $350,000 **Project Description:** The purpose of this project is to develop the Building Design Advisor, a computing platform that can provide links between building analysis tools for decision making, especially in initial schematic phases of building design. This software environment will also make it much easier for decision-makers to quantitatively assess the energy and no-energy implication of energy-efficient strategies and technologies.	**Product 1—**BDA Version 2.0 **Audience—**architectural schools, innovative architects **Product 2—**demonstrations, workshops, and a web-based distribution and feedback mechanism to facilitate development and support **Audience—**architectural schools, innovative architects **Product 3—**Commercialization plan for the BDA software **Audience—**market transformation program developers, commercial software publishers (selected parts)	• **Architectural Schools—**beta testing and early use in architectural schools will make it a tool that is valued by the next generation of architects • **BDA Suite (future work)—**create suite consisting of BDA linked to DOE-2/Energy Plus and Radiance, and linkable to a commercial CAD package; identify commercial software publisher to market suite • **Application Programming Interface (future work)—**would support the development of third-party modules • **CA Market Transformation Programs—**create programs including the above strategies

During the third and fourth quarters of 1999, CIEE has held extensive discussions with PG&E, SCE and SCG and SDG&E representatives regarding the funding of markets transformation projects based on the technologies being developed by CIEE through this Transition Program and other complementary effort. Through the end of 1999, CIEE has received $3,917,000 in funding for the energy efficiency market transformation projects listed in Table 2 that focus on emerging technologies. Although these projects are funded by individual CIEE sponsors, each has requested that CIEE explore the interest of other California utilities in the planning and funding of related co-funded or complementary market transformation projects in 2000, 2001 and future years. During the initial stages of 2000, CIEE anticipates that additional emerging technology projects will be identified for collaborative funding in 2000 and 2001.

1.8 Task 4.0 Project Management and Contracting

In addition to approving co-funding for CIEE's program management costs during this Transition Program, the Research Board also authorized the continued participation of sponsor representatives on the Project Advisory Committees for each project. CIEE coordinated with lead PIs of each project in updating the PAC roster of each ongoing multiyear project. For the Lighting Torcheres Project, a new PAC was formed. The California Energy Commission project manager was considered to be a member of each PAC and in many instances, additional Commission staff, industry and other stakeholders were invited to continue to serve or, as appropriate, become new members of each PAC.

Through the process described in Task 1, CIEE coordinated with the lead PIs of each project in determining whether modifications should be made to each Project Work Statement Task Deliverables, Schedule and Budget (Exhibit A, B and C) based on the final results of the previous project phase; (ii) comments received from each PAC on the project plan; and (iii) guidance received from the Commission project manager. Commission project manager approval of each updated project plan, CIEE then coordinated with each project team in submitting final internally–consistent proposals from each Performing Institution involved in the conduct of each project. CIEE then proceeded to negotiate R&D agreements with each Performing Institution. Table 12 identifies the various contractual agreements and lead PIs associated with each project, and the approximate start date of each agreement. Each agreement contained appropriate flow-down provisions required by the Commission in this PIER Transition Program contract.

Table 12. CIEE Subcontract Detail

Project	CIEE Project Manager	CEC Project Manager	Date Approved by CEC Proj Mgr	Principal Investigators (Lead PI denoted by *)	Performing Institution	Contract Start Date
2. Residential Thermal Distribution Systems	K. Brown	A. Peterson	9/21/02	Sherman*	LBNL	10/1/98
				Hammon	Consol	10/15/98
3. Alternatives to Compressor Cooling	K. Brown	R. Reidel	7/15/02	Loisos*	Loisos Arch.	8/26/98
				Bourne	DEG	8/26/98
				Ubbelohde	UCB	7/1/98
				Arens	UCB	7/1/98
				Hackett	UCD	8/26/98
				Huang	LBNL	9/1/98
4. Commercial Thermal Distribution Systems	K. Brown	M. Shirakh	9/12/02	Modera*	LBNL	10/1/98
				Arens	UCB	11/1/98
5. Diagnostics for Building Commissioning and Operations	C. Blumstein	J. Wang	6/22/02	Piette*	LBNL	9/1/98
				Rumsey	Supersymtry	9/22/98
				Sebald	UCSD	9/28/98
				Shockman	Shockman	12/15/98
6. High Efficiency Lighting Torchieres	C. Blumstein	M. Shirakh	8/22/02	Johnson	LBNL	10/1/98
7. Laboratory-Type Facilities	K. Brown	W. Bakken	10/7/02	Sartor*	LBNL	10/1/98
				Arens	UCB	1/4/99
				Tsal	Netsal	3/1/99
				Stum	PECI	6/18/99
8. Building Design Advisor	C. Blumstein	T. Cummins	8/10/02	Papamichael*	LBNL	9/1/98
				Protzen	UCB	11/1/98
9. Formation of NOx in Ind. Gas Burners & Stationary GasTurbines	J. Cole	M. Layton	10/9/02	Samuelsen	UCI	9/22/98

During the initial stage of each project, the CIEE Technical liaison (official CIEE designation for project manager) met with the Commission project manager identified in Table 1 to discuss how they would coordinate their efforts to provide technical and financial oversight of each project, consistent with Commission policies and procedures, the terms and conditions of the Transition Program contract and this Project 1 work statement, and CIEE's established project management policies and procedures. As described further in Task 2, CIEE was responsible for the submission of quarterly progress reports to the Commission project manager. The Commission project was also responsible for approving advanced payment requests forwarded to the project manager by the Commission contracts office, following their submission by CIEE.

For the reasons summarized in the last paragraph of Task 1, the Commission approved no-cost, time extensions for each project. Following confirmation that these no–cost time extensions would be approved by the Commission, CIEE modified its agreement with the Performing Institutions, as appropriate for a particular project.

CIEE coordinated with the lead PI of each project in submitting quarterly progress reports, task reports, and Draft Final Reports to the PAC (including Commission project manager), conducting related collaborative program planning and management and technology activities described in other tasks, and scheduling at least one PAC meeting to review the progress of each project during this Transition Program.

Following receipt of comments on each Draft Final Report, the lead PI of each project prepared a Final Report, and submitted it to the Commission project manager for approval, following coordination with the CIEE Technical Liaison. Following the acceptance of the Final Reports for Projects 2, 4, 5, 6 and 8, the Commission Contract Manager met with lead PI's of these projects to discuss additional editorial changes to these reports.

1.9 Task 5.0 Development and Management of New Multiyear Projects

Base R&D funding from its California sponsors in 1997 enabled CIEE to continue development and first phase funding of the new multiyear project: Market Connections for New Commercial Building Technologies. More information about the objectives and scope of this project is provided in Appendix V. This project and related market transformation research studies were planned and funded in close cooperation with California Energy Commission staff and other members of CIEE's Planning Committee. During the fourth quarter of 1998, CIEE staff prepared a Request for Proposals (RFP) (Appendix V) in close cooperation with a Proposal Evaluation Committee consisting of California Energy Commission and other CIEE sponsor representatives.

This RFP was issued by CIEE on December 28, 1998, requesting that proposals be submitted on March 12, 1999. The Proposal Evaluation Committee subsequently recommended CIEE selection of a proposal submitted by lead Principal Investigators, Nicole Biggart of UC Davis and Loren Lutzenhiser of Washington State University. CIEE negotiated agreements with these Performing Institutions and the project was initiated in November of 1999. A Project Advisory Committee consisting of California Energy Commission staff and other CIEE sponsors has been formed and its initial meeting was scheduled on December 14, 1999. Completion of the project's first phase is expected during the fourth quarter of 2000**.**

Funding from its California utility sponsors in 1998 and 1999 also enabled CIEE to initiate the following two new public interest R&D projects involving low NOx, energy efficient combustion of natural gas that are complementary to Project 9: (1) Ultra Low Emission Premixed Burners, led by Robert Cheng of LBNL in collaboration with Scott Samuelsen of UC Irvine, and (2) Combustion of Methane in an Oxygen-Enriched Environment, led by Fokion Egolfopoulos of the University of Southern California (USC). Because the PIER Program does not currently support public interest gas combustion R&D in industrial, commercial and residential sector applications, CIEE must rely on future voluntary funding from Southern California Gas and other California gas utility sources, if significant benefits would be derived by California natural gas consumers from continued support of these public interest gas R&D projects.

1.10 Task 6.0 Technology Transfer

Whenever possible, CIEE integrated information dissemination and technology transfer activities into the planning and conduct of each project. These include PAC meetings, workshops, technical presentations at conferences, publications of articles in peer–reviewed journals, development of industry standards and guidelines (e.g. ASHRAE and ASTM standards, California building construction protocols, etc). project–specific Web sites, and, in limited instances, filing of patents and software copyrights and licensing of intellectual property. These are described in the Final Report of each project and are not repeated here.

As described further in Task 3, CIEE coordinated initially with its Research Board in conceptualizing an Emerging Technologies Initiative that would foster the initial market introduction of CIEE and other PIER — developed technologies and new applications knowledge as part of the market transformation programs of California's major utilities. As part of this process, Karl Brown, CIEE's Building Systems Program Manager, collaborated with Nancy Jenkins in preparing Table 6 through 11, summarizing PIER Transition Program Research Results and Market Penetration Strategies for CIEE projects 2, 3, 4, 5, 6 and 8. Ms. Jenkins distributed these to the market transformation program representatives of California's utilities and CBEE and other stakeholders for their consideration. As described in Task 3, CIEE is coordinating with PG&E, SCE, SCG and SDG&E in the planning and funding of specific market transformation projects in 1999 and future years.

During the first quarter of this Transition Program, CIEE completed a major upgrade of its Web site for purposes of providing up–to–date summary level information about the status of each ongoing multiyear project, including the results of the previous phase of these Transition Program projects. Cross-references were made to the individual Web sites maintained by the lead Principal Investigator. During the last quarter of 1999, CIEE has completed a second major upgrade of its Web site that included the results of each Transition Program project as well as the other projects and Emerging Technologies Initiative highlighted in Task 3. During the last quarter, CIEE also prepared and distributed a 1999 Annual Report, based on the upgraded Web site information highlighted above.

1.11 Task 7.0 Triennial Program Review

During the fourth quarter of 1998, the CIEE Director met with Commission staff involved in the management of the PIER program to discuss CIEE's Draft Plan for the conduct of its third Triennial Review during the first or second quarter of 1999. Based on feedback received at this meeting, particularly Commission staff perception of the need to include additional California building and other industry representatives on the Review Panel, CIEE prepared a Final Plan for this Triennial Program Review. This revised Plan was discussed with Commission R&D Committee on February 10, 1999, including the CIEE Director's recommendations regarding potential members of the 1999 Review Panel.

Based on the comments received from the Commission R&D Committee, the CIEE Director coordinated with Robert Shelton, UCOP Vice Provost for Research, in making the final selection of Panel members, finalizing the "charge" to the Panel, scheduling a two-day Panel meeting and forwarding background information about CIEE and its R&D program to the Panel in advance of this meeting.

The CIEE Director also solicited comments from the Research Board and Commission R&D Committee on CIEE's performance over the past three years. These comments were provided directly to the Panel Chair to provide a channel for encouraging the communication of frank assessments of CIEE's performance. Comments received from the Research Board and the process for soliciting them is described further in the Review Panel's Final Report (Appendix VI).

On April 12 and 13 of 1999, the Triennial Review Panel met with UCOP, CIEE and Commission representatives, Nancy Jenkins and Scott Matthews, several lead PIs of CIEE Transition Program projects, and other invited guests (e.g. Carl Weinberg, a member of the PIER Independent Review Panel, and Robert Raymer of the California Building Industry Association). The Panel reviewed CIEE's R&D efforts over the past three years (including the initial stages of this Transition Program) and comments received from the CIEE Research Board. Following this meeting, the Panel prepared the Final Report provided in Appendix VI.

The following selected portions of this Final Report summarize the major findings of this Triennial Program Review Panel:

- The Panel concluded that the overall quality of the CIEE program was outstanding (scoring 3.35 on a scale of 1=poor; 2=fair; 3=good; 4=excellent). The value of the program (to California stakeholders) was also rated outstanding (scoring 3.43). It is noteworthy that the "user" members of the panel saw the "value" as slightly higher than the members on average. It is also noteworthy that CIEE achieved this rating despite the uncertainties of the past several years. The Panel attributed much of CIEE's outstanding performance to the efforts of a very dedicated staff committed to the mission of improving energy utilization in California.
- The CIEE stakeholders have invested substantially in CIEE for ten years. Over that time, CIEE has learned much and matured into an outstanding energy research management organization. Specifically it has learned to:

- Consider the potential benefits (if successful) from a total energy perspective before project initiation;
- Consider the infrastructure required to successfully deploy products in the market place and bring that infrastructure together early in the research phase;
- Be flexible in managing intellectual property (owning intellectual property is not always the most effective way to optimize benefits for California stakeholders) as well as in negotiating other contractual requirements;
- Network with other California stakeholders to assure that interests are brought to the table; and, conversely, that these other stakeholders are available to expedite market transformation.

- The Panel asked each of the principal investigators who made presentations during the review whether the specific research would have been undertaken without CIEE involvement. In every case the answers was either a) the work would not have been undertaken at all or b) the work might have been sponsored by someone else, but the results (to the market place) would have been delayed by many years (i.e. ten years in the case of duct sealing). Thus, the Panel concluded that CIEE might be unique in its role as well as in its maturity and its approach to energy research management.
- Specific comments of Panel members include:

  "Remarkable that program has stayed alive in such a turbulent funding climate. A real credit to the tenacity and commitment of CIEE management."

  "CIEE has done an excellent job of bringing the end-users / and industry partners into each of the projects — yielding a high probability of successful commercialization. This is really rare in the R& D world."

  "Excellent in getting solutions into the marketplace (e.g. duct sealing, building codes)."

  "Bringing results of project to the 'public' is very important — need to keep up that good work. CIEE shows dedication and commitment."
- In answer to the question, "should CIEE have a continuing role in California's energy future?" The Panel responded with a score of 3.43 (1=absolutely no; 2=no; 3=yes; 4=absolutely yes). If CIEE's capabilities are lost to California, there is no doubt that there will be a significant cost (or lost opportunity) to California energy stakeholders.

The Triennial Review Panel's concluded that CIEE should have a continuing role in California's energy R&D future and that this role should be affiliate or adjunct to the Commission for the management of an appropriate portion of the PIER program, and not in the form of a subcontractor relationship. The Panel also concluded that "CIEE should work through its Research Board and the private sector electric utilities to manage a portion of the Energy Efficiency Market Transformation (EEMT) funds as well as continue to manage targeted research funds for other organizations. "CIEE should position itself to "tie" the Commission PIER efforts to the EEMT and other market place activities."

The CIEE Triennial Review Panel Report was distributed to the CIEE Research Board in June of 1999 and the CIEE Director met with each Board member to discuss its findings. The Panel Report was also distributed to the California Energy Commission R&D Committee in June of

1999 and Robert Shelton and the CIEE Director met with the R& D Committee on July 26, 1999 to discuss the recommendations of the Triennial Review Panel.

1.12 Major Project Outcomes

The following are the principal outcomes of Project 1:

(1) Significant progress was made in developing the new end-use efficiency technologies considered in Projects 2 through 9; this progress is summarized in Section 2 and described in more detail in the Final Report of each project. Summary level information about the development status of these CIEE technologies and their public interest R&D, economic and environmental benefits are available through CIEE's Website at http://www.ciee.ucop.edu/.

(2) CIEE coordinated with the R&D leaders of Projects 2 through 9 and several other recently-completed CIEE projects and with energy efficiency market transformation (EEMT) representatives of PG&E, SCE, SCG, SDG&E and SMUD in exploring initial market applications of these CIEE-developed technologies as part of the EEMT programs of these California utilities. Table 2 identifies 12 CIEE Supplemental projects with a total funding of $4.4 million that will be contracted by CIEE during the first quarter of 2000 with funding provided by PG&E and SCE in December of 1999. CIEE anticipates that additional market transformation applications of these and other CIEE-developed technologies will be funded by California's six largest electric and gas utilities (through CIEE) in cooperation with the Energy Commission, EPA, DOE and other market transformation entities in 2000 and 2001 as part of a statewide coordinated Emerging Technologies Initiative. CIEE recommended the establishment of this coordinated Initiative to the California Board for Energy Efficiency and the CPUC in June and July of 1999.

(3) CIEE coordinated with the R&D leaders of each Project team in exploring opportunities for continued funding of these R&D projects through the PIER General Solicitations and the Buildings Energy Efficiency Programmatic Solicitation. The R&D leaders of Projects 2, 3, 4, and 5 have been successful in obtaining PIER R&D funding support from the California Energy Commission for major components of these projects. CIEE and the California Energy Commission representatives are currently exploring the possibility of continued funding of Project 7 during the initial stages of 2000.

(4) CIEE conducted an initial assessment of the potential public interest R&D benefits of continued funding of selected aspects of Projects 2 through 9. This assessment is contained in Section 2 of this report.

(5) CIEE collaborated with Energy Commission staff and CIEE Sponsor representatives in preparing and issuing a Request for Proposal (RFP) to select a research team and detailed research plan for the CIEE multiyear project: Market connections for New Commercial Building Technologies. A Proposal Evaluation Committee consisting of Energy Commission and other CIEE Sponsor representatives and stakeholders recommended the selection of the research team led by Nicole Biggart of UC Davis and Loren Lutzenhiser of Washington State University to conduct this project. This project was initiated in December 1999 with $340,000 in first phase funding provided by CIEE's utility Sponsors.

(6) CIEE collaborated with Southern California Gas and other CIEE Sponsor representatives in planning and funding two public interest R&D projects involving the Low NOx, energy efficient combustion of natural gas in industrial, commercial and other market applications.

(7) CIEE coordinated with the Energy Commission R&D Committee in planning and conducting the third Triennial Review of CIEE and its R&D Program by an independent peer review panel in April of 1999. As summarized in Task 7 (i.e. Section 1.11) and described in its final report in Appendix VI, this CIEE Triennial Review Panel concluded that the overall quality of CIEE's R&D program was outstanding. The Panel concluded that "CIEE should have a continuing role in California's energy R&D future and that this role should be affiliate or adjunct to the Commission for the management of an appropriate portion of the PIER program, and not in the form of a subcontractor relationship." The Panel also concluded that "CIEE should work through its Research Board and the private sector electric utilities to manage a portion of the Energy Efficiency Market Transformation (EEMT) funds as well as continue to manage targeted research funds for other organizations. "CIEE should position itself to "tie" the Commission PIER efforts to the EEMT and other market place activities."

(8) The Commission R&D Committee expressed interest in negotiating a Technical Assistance agreement with the University of California (UC) Office of the President (UCOP) for purposes of enabling the Commission to use CIEE and other scientific, technical, R&D program planning and management expertise at California's universities, colleges and national laboratories in the implementation of the PIER program; a preliminary description of technical assistance activities which might be undertaken by CIEE is provided in Appendix VII. The Commission's Building End-Use Efficiency Program Manager and the CIEE Director have discussed an initial technical assistance work scope that both view as a conceptual starting point for collaboration in the planning and management of this PIER program area; a summary of this potential work scope is provided in Appendix VIII. Commission and UCOP representatives are discussing the establishment of an interagency agreement for this and other related PIER purposes.

1.13 Conclusions and Recommendations

Although the Commission is providing continued funding support of selected aspects of Projects 2, 3, 4, 5 and 7, CIEE believes that significant R&D benefits would be derived by California energy consumers from continued funding support for additional elements of Projects 2 through 9 as described further in Section 2. CIEE recommends that the Energy Commission consider funding this work as part of future phases of the PIER program.

CIEE plans to involve the Commission staff and other Sponsor representatives in monitoring the progress of the energy efficiency market transformation projects listed in Table 2. CIEE anticipates that additional emerging technology projects may be identified, planned and funded by California utilities in cooperation with CIEE and the Commission as of a coordinated statewide Emerging Technology Initiative that helps to bridge the PIER program with the energy efficiency market transformation programs of the California utilities.

As summarized previously, CIEE planned, funded and is managing the first phase of the Market Connections for New Commercial Building Technologies project and a related scoping

study as part of this Transition Program using funding provided by California utilities in 1997. If the results of this first phase are promising, the Commission should consider funding future phases of the public interest R&D aspects of these Market Transformation Research projects through the PIER program. CIEE will coordinate with its California utility Sponsor in funding related market transformation aspects of this project, possibly as part of a joint project with the Commission.

With funding support and strong encouragement from Southern California Gas, CIEE has been able to plan, fund and manage three multiyear research projects involving the Low NOx, energy efficient combustion of natural gas in industrial, commercial and other market applications. Without continuing funding from SCG and other California gas utilities, CIEE will not be able to continue to support these or other promising public interest R&D projects that offer the potential to yield significant energy efficiency, economic and environmental benefits for California's natural gas customers. CIEE recommends that the Energy Commission explore how it can collaborate with CIEE, its Sponsors and other stakeholders to sustain continued support of promising public interest R&D projects that benefit California's natural gas customers, including integration of these efforts with the PIER program.

CIEE and the Commission staff were able to work together effectively with the leaders of each project team in the management of this PIER Transition Program. Through the use of task-level deliverables, quarterly progress reports, Project Advisory Committee meetings and other periodic project review meetings, CIEE's project managers and the project team leaders enabled the Commission project managers to make the key project management decisions associated with the conduct of each project, while delegating responsibility to the CIEE project manager to monitor project technical progress, review and approve invoices associated with the financial, and explore market transformation and other technology transfer opportunities with project team leaders. This approach fostered the effective use of limited Energy Commission project management resources.

CIEE effectively utilizes Project Advisory Committees (consisting of Commission, other CIEE Sponsor, industry and other stakeholder representatives) to provide useful technical and market input in the conduct of each project and to explore initial market application of these technologies as part of California utility energy efficiency market transformation programs and the related voluntary new construction and Title-24 initiatives of the California Building Industry Association (CBIA), the Commission and other stakeholders. CIEE would not be able to sustain the use of these Project Advisory Committee resources without the support of its Research Board.

Based on the productive experience of collaboration between CIEE and the Commission staff in the management of this Transition Program and the progress already achieved in linking this effort with the energy efficiency market transformation programs of PG&E and SCE, CIEE recommends that Commission consider establishing an interagency agreement with UCOP during the first calendar quarter of 2000 that can effectively "tap" the full range of CIEE and UC capabilities as recommended in the final report of the CIEE Triennial Review Panel. The scope of this interagency agreement might include: (1) R&D program and project planning; (2) program and project management; (3) coordination and collaborative PIER and EEMT funding and contracting of interrelated R&D and market transformation projects; and (4) development of other technology transfer and collaborative funding opportunities.

Finally, one of the keys to CIEE's success (since its first year of full scale operation in 1990) has been its ability to collaborate with the Commission and other Sponsors in the planning, funding and management of **innovative, leading-edge, multiyear public interest R&D projects**. These have normally been launched following scoping studies, planning workshops, industry and other stakeholder outreach efforts, followed by the development of a Request for Proposal that focuses on the relevant R&D issues and the involvement of stakeholders in the review and selection of the best proposal(s) for funding. Projects 2, 3, 4, 5, 7 and 9 and the new Market Connections project are specific examples of CIEE projects that were initially developed through this structured process. With the exception of the Market Connections project, CIEE has not been able to initiate any new innovative, leading-edge multiyear project through this process since 1994 because of uncertain prospects for continued Base Program funding from California utilities because of deregulation uncertainties. Although many of the Energy Efficiency and other projects funded by the PIER program have involved the further development of promising new energy technologies, very few if any promising innovative, leading-edge, new research opportunities are being pursued by the major PIER Energy Efficiency programs. Moreover, CIEE does not believe that the Energy Innovation Small Grant program is either the most effective or the only means that should be used to identify and develop new technologies and strategies for achieving the R&D goals and objectives described in the Commission's PIER program plans. Consequently, based on its established track record, CIEE recommends that the Commission collaborate with CIEE, its Sponsors and other stakeholders in planning, funding and managing at least two innovative, leading-edge Buildings and Industrial Energy Efficiency projects per year funded by PIER through a similar process.

2.0 Section 2: Conclusions and R&D Recommendations—Projects 2 through 9

2.1 Introduction

This section summarizes CIEE's conclusions about the accomplishments of Projects 2 through 9. This is accompanied by CIEE's perspective on high priority needs for further public interest R&D that will foster further development and initial market adoption of the new technologies considered in these projects. The final report of each project provides the Principal Investigator(s)' perspective on each project's objectives, outcomes, conclusions and recommendations regarding RD&D needs.

2.2 Residential Thermal Distribution Systems

Almost ten years of CIEE-funded R&D has led the way to elimination of substantial energy waste from duct distribution systems. Market mechanisms are now being put in place that will foster improvements in duct efficiency and the capturing of significant amounts of consumer savings. Such extensive RD&D efforts funded by CIEE, PIER (Transition Project) DOE, EPA, utilities and other organizations have achieved the following important impacts:

- Created a strong enough body of knowledge to change long standing erroneous perceptions about duct performance;
- Provided the technical basis for the market transformation programs now taking effect; and
- Developed new technology that improves the economics of duct sealing.

As important as it is, the current body of knowledge is only enough to illustrate and capture the first order or primary effects of reducing duct leakage. The direct savings from simple duct improvements can be now be easily assessed, and are, in many cases, sufficient to justify the cost of these measures. However, this is only enough to achieve partial market penetration. Further research is needed to evaluate and document the full benefits of improved ducts and to facilitate greater market penetration through the efforts of California's energy services industry.

For example, improving ducts also improves overall residential HVAC system performance, allowing downsizing of HVAC equipment and improvements in comfort. Also, duct improvements can be synergistic with other HVAC system improvements, further increasing value to the consumer. Finally, future time-of-use weighting for energy standards or time-of-use pricing standards may increase the value of duct improvements and related measures even more.

Further efforts are also needed to provide continued technical support is needed for ongoing technology transfer efforts toward duct sealant longevity test methods, distribution system evaluation standards, and duct leakage test standards. In addition, the first Title 24 cycle containing mechanisms to encourage improved ducts is just in its early implementation stages. There is a need to evaluate the effect of these Title 24 changes, toward making further improvements in the future.

Additional fundamental improvements in duct systems are still possible, ranging from integrated house design with ducts in the conditioned space to improved duct connection hardware. Investigation of leakage from HVAC equipment cabinets is another important area

for further research. Development of hydronic systems as an eventual alternative to ducts is also a potentially productive effort.

In summary, additional research is warranted to:

- Fully evaluate the effects of improved ductwork on system capacity, including synergistic effects with other system improvements;
- Fully evaluate the potential interaction between improved ducts and time-of-use pricing or time-of use weighting in future Title 24 cycles;
- Develop additional technical information in support of the development of test methods for duct sealant longevity, duct leakage test methods and standards for evaluation of distribution system performance;
- Evaluate the newly implemented Title 24 features intended to encourage better ducts;
- Investigate fundamental improvements in duct technology and distribution system alternatives; and
- Evaluate HVAC equipment cabinet leakage, toward development of strategies to minimize this energy loss mechanism.

There are two projects being funded, by the California Energy Commission (through the PIER program), and by Pacific Gas & Electric (PG&E) (with supplemental project funding provided through CIEE), which will address some of the above agenda. The objective of PIER Residential Commissioning project, led by LBNL, is to demonstrate the value that performing residential commissioning services would have in both new and existing residences and to develop and document residential building commissioning procedures. In the PG&E funded project, LBNL and California State University at Chico will undertake a series of technology evaluation and demonstration tasks in support of PG&E's energy efficiency programs in new and existing residential buildings, including Building America and Energy Star. Tasks include field research on older homes, demonstrating improved designs for new homes, developing tools suitable for contractors and subcontractors in sizing cooling systems, installing and testing ducts, and in using simulation programs to evaluate new technologies. CIEE is still in the process of assessing the potential of these projects to address the key needs highlighted above and exploring opportunities for addressing the most important unmet needs in cooperation with its Sponsors and other R&D and market transformation organizations.

2.3 Alternatives to Compressor Cooling

Prototype house designs were developed for both Northern and Southern California climates, which offer the potential to implement low energy, compressorless cooling technology. The approach uses night ventilation in conjunction with energy efficient building envelope, inexpensive thermal mass and other building system enhancements to maintain occupant comfort in California transition climates. Moreover, a substantially downsized compressor-based cooling system (1.5 tons), when operated in conjunction with the night ventilation and other building system enhancements, will maintain occupant comfort in all but the most severe hotter inland climates. A user interface was developed which would enable building occupants to effectively operate this low energy cooling system in a manner that maintained comfort and

reduced compressor use during heat storm conditions. Builders and developers expressed preliminary interest in these prototype house designs.

CIEE believes that continued R&D, demonstration and market transformation efforts are warranted in the following areas:

- Evaluation of pilot houses or subdivisions using project designs and concepts (this is a considered a high priority for continuation funding)
- Optimization of indirect evaporative cooling equipment and other low-capacity cooling equipment to match the low cooling loads associated with project systems
- More thorough and systematic study of occupant interactions with the controls for alternative systems (including low-capacity systems) toward improved user acceptance of controls and systems (this is considered a high priority for continuation funding)

An alternatives to compressor cooling project funded by PIER will partially address these items. CIEE is collaborating with its Sponsors in assessing the potential of this project to address these and other unmet R&D needs and exploring opportunities for addressing them.

2.4 Commercial Thermal Distribution

R&D that focuses on improving the performance of commercial thermal distribution systems lags residential thermal distribution efforts by a few years. As a result of CIEE, PIER Transition Project, and related efforts, researchers understand the extensive energy waste from leaky non-residential ducts. However, unlike residential ducts, there is not yet a strong enough body of knowledge to change the longstanding misconceptions about the importance of duct leakage. Industry and consumers generally remain unaware of the large savings opportunities. A similar lack of knowledge is also inhibiting efforts to increase the efficiency of large fan systems in commercial buildings (as represented by the progress in diagnostic protocols and performance benchmarking by this project).

Diagnostics for residential ducts are coming into fairly wide use as a result of ongoing research efforts including this PIER Transition project. However, diagnostics and measurement techniques for non-residential systems are still generally in the research stage. Research in non-residential systems is also a few years behind residential systems with respect to the performance characterization necessary to implement effective changes to the title 24 standards. This PIER Transition project identified some of the work necessary to achieve this. Finally, though substantial progress was made during the PIER Transition project, aerosol technologies are taking longer to adapt to non-residential applications because of the larger size and greater complexity of the systems.

The research agenda for Commercial Thermal Distribution Systems includes:

- Additional field work to characterize the magnitude of the energy waste in different types of non-residential buildings;
- Further assessment of modeling improvements needed to make DOE-2 a useful tool to implement compliance options and development of those modeling improvements to be implemented in DOE-2, including: definition of duct conditions in the standard building, development of technical basis for ACM compliance tests for evaluating duct performance,

documentation of the impact of duct efficiency measures in actual buildings, creation of practical duct leakage measurement techniques for widespread application, development of technical basis for time-of-use weighting in analysis of performance and savings;

- Basic technology development to increase the efficiency of the aerosol sealing process and to determine and mitigate impacts on the wide range of equipment associated with non-residential systems;
- Further performance characterization for large fan systems including initial population of the nascent fan performance database created through this PIER Transition project and previous CIEE efforts (this is considered to be a high priority for continuation funding);
- Further technology development of low-cost flow measurement systems; and
- Research on the range of system impacts on HVAC equipment performance and sizing.

The new project funded by PIER will partially address the agenda items relating to ducts. However, CIEE is concerned about the lack of continued funding support for R&D on the performance of large fan systems, which it considers to be a high priority. CIEE is in the early stages of assessing the potential of ongoing RD&D efforts to address unmet needs in this topic area and exploring opportunities to address them in cooperation with its Sponsors and other R&D organizations.

2.5 Diagnostics for Building Commissioning and Operations

Over the 1994 through 1999 timeframe, CIEE funded the background research, engineering design, installation and testing of the Information Monitoring and Diagnostics System (IMDS). A project team led by LBNL conducted this work. This technology was developed in close cooperation with the commercial property management industry, CIEE's Sponsors and the U.S. Department of Energy (DOE).

In this PIER-funded effort, the project team recently completed an analysis of the performance of a first-generation IMDS in a commercial office building in San Francisco at 160 Sansome Street (http://eetd.lbl.gov/EA/ITT/diag/). Jones Lang LaSalle, Incorporated, a leading property management company, expressed interest in cost-sharing a test of this first-generation IDMS at its 160 Sansome Street site and has agreed to be CIEE's commercial partner in a second-generation IMDS demonstration project in a large commercial building at 925L street in Sacramento.

The 160 Sansome Street project showed how sophisticated performance monitoring and data visualization tools can be extremely useful to building operators and property managers. This IMDS technology saves energy use, reduces operating costs and improves comfort. The IMDS consists of high quality sensors and data acquisition system that provides high quality performance measurements archived each minute, a data visualization tool, and a web-based data retrieval and analysis capability. Commercially available Energy Management and Control Systems (EMCS) do not currently possess these IMDS capabilities.

The IMDS system has been used to identify and correct a series of control problems at 160 Sansome Street. It has allowed the operators to make more effective use of the building control system, thereby freeing up time to take care of other tenant needs. The IMDS significantly improves building comfort and potentially improves occupant health and tenant organizational

productivity. It is estimated that $20,000 annual savings has been realized by reducing building operating costs, which would pay for the IMDS in about five years. A control system retrofit based on findings from the IMDS is expected to reduce energy use by 20 percent over the next year -- a minimum potential saving of $30,000 annually. Based on the results of this project, the property managers have collaborated with the project team in developing a technical specification for a new building control system that will incorporate many IMDS capabilities.

CIEE and the project team anticipate that IMDS sensor and installation costs will be significantly reduced and overall cost effectiveness improved when considerable market demand is created for this technology by the property management industry.

One overall goal of CIEE's second-generation IMDS R&D project at 925L Street in Sacramento is to demonstrate and evaluate the value and usefulness of this technology at a second site that provides a more generic operational context and experiences more severe cooling, heating and other HVAC loads. The project will also further develop and demonstrate new IDMS capabilities, such as the automation of diagnostics and fault detection that are of interest to the property management industry and CIEE's Sponsors. It is anticipated that additional development will produce further cost-effective optimization of the technology.

In addition, several specific R&D issues will be addressed by this project. First, will the building operators at 925L Street effectively utilize and derive significant benefits from the use of the IMDS technology in a manner comparable, superior, or perhaps at a lower level than that experienced at the 160 Sansome Street project?

Second, because the EMCS at 925 L Street is far more sophisticated than the one at 160 Sansome Street, all project participants are interested in determining whether this more capable EMCS can be used for handling the majority of the diagnostics tasks that will be conducted at 925 L. An alternate result would be confirmation that an IMDS-type technology is essential to achieving comparable benefits to those obtained at the 160 Sansome Street project. The primary diagnosis at 160 Sansome Street could not have been done with EMCS at that site. The on-site comparison of the IMDS with a state-of-the-art EMCS is critical to a definitive evaluation of the technology characteristics. Other R&D questions that this project will address are: how effective is the IMDS platform for deploying automated, on-line, model-based diagnostics, and how can such systems be made useful to the building operators?

CIEE believes that the commissioning and diagnostics research tasks included within the new PIER-funded and LBNL-led High Performance Commercial Building Systems project will synergistically complement the CIEE-funded efforts in 925 L Street project. Although neither CIEE IMDS project is explicitly mentioned in its proposal, the LBNL-led project team intends to utilize data from both the 160 Sansome Street and 925L Street (along with other case studies) in this new PIER-funded project. The majority of commissioning and diagnostics research on existing buildings in this new project is oriented toward working with EMCS data, which has its own set of technical challenges. The CIEE IMDS project at 925L Street presents an excellent opportunity to take the alternative approach to improving state-of-the-art building operations—developing concepts independently from the adaptation of conventional EMCS technology for quality performance monitoring and diagnostics. CIEE recommends that the Commission integrates the ongoing results of the 925L Street project into the overall planning and management of the High Performance Commercial Buildings Systems project.

CIEE believes that agenda for further research in this area also includes the following activities, which are yet to be adequately funded:

- Field evaluation of diagnostic potential in other types of large or complex buildings (i.e. Medical Centers);
- Further efforts to automate diagnostics and fault detection;
- Development of methods to accelerate the technology adoption process;
- Further evaluation of potential for feedback of diagnostic information to the design process for renovations or new buildings;
- Linking of technologies with design tools, to foster interoperability and integration; and
- Application of the IDMS technology in low-rise commercial and industrial buildings. This could include remote monitoring and analysis of building performance and diagnostic information by specially trained HVAC system operators, combined with as-needed communications with less-sophisticated building operating personnel.

CIEE will be exploring opportunities to address these RD&D needs with the Commission staff and Sponsor representatives in 2000 and 2001.

2.6 High Efficiency Lighting Torchieres

The lighting industry does not generally do the research and development necessary to produce efficient high-performance lighting systems using compact fluorescent or other efficient lighting sources. Integrated design is necessary to obtain efficiency and performance from these light sources, which have a range of complex shapes. The lamp and fixture industries are almost completely separate and do not usually work together to integrate efficient lamps into fixtures. In addition, the lighting fixture industry is highly fragmented with no organization having the resources to create the research infrastructure or conduct the advanced design studies to produce efficient products. No industry organization exists to pool resources for such a purpose.

R&D into efficient compact fluorescent lighting system design is an appropriate use of public interest funding, as equivalent work will not be performed by the private or regulated sectors.

High efficiency is one goal of advanced design research. However, substantial public benefit is also obtained by moderately efficient systems that actually succeed in consumer markets. Incandescent systems are highly competitive with consumers because of their functionality and low first cost. R&D is useful to produce compact fluorescent systems that match or exceed the functionality of incandescent systems, with first cost that is not prohibitive. Many current compact fluorescent systems have poor dimming performance. The longer lamp life and life-cycle economy that compact fluorescent sources promise can be lost because of poor thermal design of fixtures. Integration of the more complex fluorescent lamp / ballast systems also presents a challenge. All of this must be accomplished with low manufacturing costs.

The lighting industry has not organized the technical resources to meet these challenges and capture the promise of compact fluorescent lamps. This limited R&D project (less than $100k per year) has produced efficient prototype fixtures for one of the many potential applications of compact fluorescent lamps, with improved functionality and a focus on cost-control. Pending

lighting industry initiatives in this area, CIEE recommends that continued R&D in this area is warranted for the following purposes:

- To continue to increase functionality and lower costs for important office applications,
- To provide the same advanced design capability for other conventional applications for compact fluorescent lamps, and
- To develop new applications for compact fluorescent lamps that will displace more energy-intensive lighting systems

2.7 Cleanrooms and Laboratories for the Electronics, Biotechnology, Pharmaceutical, and Other High-Technology Industries

California's high technology laboratories and cleanrooms have unique needs for carefully controlled environmental conditions. These needs are usually met by systems that are extremely energy-intensive. The HVAC energy intensities for these buildings are 4 to 40 times higher than the average commercial building. This market is large and growing rapidly with the trend toward even more energy-intensive spaces. In California in 1993, these facilities were estimated to consume about 2GW of electrical demand, approximately 9.4 billion kilowatt hours of electricity and 25 trillion BTUs. CIEE-funded research over the 1995-2000 period conducted by LBNL has shown that there are major opportunities for energy savings in this high technology sector. Key findings include:

- Savings of 30-50 percent of the building's energy use are achievable using currently available technology.
- The target for energy savings is the HVAC system, which accounts for 50 percent or more of the total energy use.
- Laboratory fume hoods are a significant contributor to HVAC energy use. A new fume hood technology being developed by LBNL in cooperation with industry might save up to 50 percent of the energy use caused by conventional laboratory fume hoods.
- Current pervasive and deeply ingrained practices used by the laboratory and cleanroom design and engineering professionals fail to capture significant opportunities for improving energy efficiency and reducing energy costs in these high technology buildings.

The goals of this CIEE multiyear project are to capture these energy efficiency and economic savings in a manner that is fully embraced by the design / engineering community by:

- Developing new technologies, including but not limited to new design and engineering practices and analytical tools;
- Transferring these technologies to this community; and
- Stimulating the use of underutilized energy efficiency technologies by this community.

LBNL estimates that there is the overall technical potential to reduce energy use in existing and new facilities by 50 percent. The energy and cost savings that are actually achieved will depend on the amount of investments in R&D and technology transfer made by the public and private sectors. It will also be dependent on the resulting rate of adoption by the high technology facility owners and the design, engineering, construction, and facility operating communities.

The following list identifies eight major components of this CIEE multiyear project and the major outcomes obtained by the LBNL during this PIER Transition Program:

- Design Intent Documentation—a first generation database was developed and used to capture design intent information from a UC Santa Cruz case study (of the Design Guide developed in previous project phases);
- Laboratory Fume Hood—development and testing continued for a prototype low flow fume hood, including identification of two potential field test opportunities;
- Laboratory Airflow Design— software implementations were investigated for algorithms developed to model dynamic multifan airflow;
- Laboratory Benchmarking Tool—development was continued for this tool, with buildings and performance data added into a second-generation database;
- Laboratory Technology Transfer the Energy Efficient Laboratory Design Guide was maintained with a second case study initiated at UC Santa Cruz to document its use;
- Cleanroom Benchmarking development was continued for benchmarking tool for cleanroom applications including refinement of metrics and disseminated case studies on LBNL website;
- Cleanroom Analysis Tools—evaluation was continued for cleanroom analysis tools and need for enhancements to existing computer-based energy analysis tools (e.g. DOE 2.2);
- Cleanroom Industry Liaison—several workshops were hosted to disseminate R&D products and identify industry R&D needs.

Based on its experience with this LBNL multiyear R&D effort and industry public interest R&D needs, CIEE recommends that a high priority should be given to continued public interest R&D funding of the following program elements:

- Laboratory Benchmarking—It is now appropriate to seek an initial (alpha) population of the database, followed by modeling refinements. There is partial funding available from the U.S. EPA.
- Design Guide—The web-based design guide needs continuing maintenance and upgrading based on continuous technical advancements.
- Laboratory Design Intent Tool—Alpha testing and refinement of the design intent documentation tool is now appropriate.
- Improved Containment Technology for Fume Hoods-R&D through alpha and beta testing will be necessary before commercialization. This includes integration in current fume hood designs, performance acceptance testing, and codes and standards work. This has some continuing funding from the U.S. DOE and Montana State University.
- Cleanroom Programming Guide -this is a new activity that was identified during the execution of the current project phase. An analog to the laboratory design guide is needed for cleanroom facilities, oriented toward the earlier phases of the building process (i.e. programming). There is cost sharing available for this from the Northwest Energy Efficiency Alliance.
- Cleanroom Benchmarking-This is a complementary extension of the Laboratory Benchmarking effort identified above. Work during the current PIER Transition project

identified the potential energy efficiency benefits, the public interest R&D need, and potential industry interest in using such a Benchmarking.

If sufficient public interest R&D and energy efficiency market transformation funding are available, CIEE recommends that the following activities be funded to accelerate the application of energy efficiency technologies and practices in this important California industrial sector:

- Code & Standards- There is a need for continuing investigation of the technical basis of current codes and standards, toward identifying opportunities to upgrade codes and standards according to new knowledge and technology
- Laboratory Air Flow Design Tool- Conversion of modeling algorithms into software tools is the next step in the development of this technology.
- Additional Technologies- Potential for the improvement of an array of technologies was identified during the execution of the current phase including: filters, fan-filter (package) units, mini-environments, wide-area particle counters, process load reductions, sound cancellation technology, efficient remote lighting systems, and control systems that optimize energy efficiency in clean room systems.

With supplemental project funding provided through CIEE, PG&E will be supporting some ongoing LBNL efforts in this area. This work will demonstrate the low-flow fume hood at a university facility in California and benchmark the energy efficiency performance of biotechnology and high technology facilities within various cleanliness categories. CIEE also anticipates that the Commission will provide PIER funding (through CIEE) of a complementary LBNL project. This effort will focus on the R&D needs identified in items 3, 4 and 5 in the above list as well as an industry cleanroom energy R&D roadmapping component. CIEE recommends that additional funding be provided for high priority items 6 and 8 in the near term and item 7 over the longer term.

2.8 Building Design Advisor

CIEE believes that the Building Design Advisor (BDA)'s primary value is as a platform for an interoperable design, analysis, and operations software environment. Such a building life-cycle software environment is necessary to maximize building quality and minimize life-cycle costs for consumers. BDA's interlinked databases of object-oriented building representations can enable the shift to paperless building documentation. The building industry lags other industries in this information-age advance, inhibiting both industry profitability and provision of high value to consumers.

The building industry is too fragmented to organize the resources for R&D toward fundamental advances in building information system technology. Public interest research has an important role in providing the framework for an interoperable software environment. Such efforts are needed to maintain an "open" software development environment that can be accessed by any industry group, and to develop a critical mass of interoperability that can be built upon by the many components of the fragmented industry.

From a building information technology perspective, CIEE believes that significant energy efficiency benefits would be derived from continued funding of the following BDA-related efforts:

- Enhance the development of links to tools that address the whole building life cycle, from design through construction and commissioning, to operation and eventual demolition (this includes, initiating the development of a BDA-based Issue Based Information System (IBIS) that will facilitate the BDA framework as a collaborative, concurrent design environment);
- Develop links to commercial architectural computer-aided drafting (CAD) software, which will allow for graphical specification of spaces and building components in three dimensions;
- Develop links to the Radiance lighting simulation and rendering software, which will allow designers to properly address quantitative and qualitative lighting, daylighting and esthetic performance issues; and
- Expand the BDA libraries of building components and systems to include more options, preferably actual products from manufacturers.

DOE is currently supporting the development, test, and release of Version 2.0 of BDA, including links to DOE-2 building energy performance and Radiance daylighting analysis computer programs. With the development of EnergyPlus Version 1.0, DOE will support LBNL's efforts to link BDA with this new building energy performance analysis tools. In FY 2001, CIEE anticipates that DOE will support LBNL's efforts to transfer development and commercialization responsibilities for BDA to the private sector.

2.9 Formation of NOx in Industrial Gas Burners and Stationary Gas Turbines

With R&D funding provided by CIEE and other sponsors over the past several years, UCI has developed new knowledge and several new technologies for the improvement of industrial combustion processes. This has included advanced sensors and combustion controls that can attain and maintain the energy efficient operation of natural gas burners with ultra-low emissions of NOx.

In this PIER-funded Transition project, UCI identified and advanced the development of advanced, fast-feedback, combustion sensors and other key elements of a closed loop combustion control system. The project went on to successfully demonstrate the technical feasibility and performance of this technology in industrial boilers and stationary gas turbines, both applications targeting the electricity production market.

Flame radical chemiluminescence of OH and carbon dioxide showed the most promise as fast feedback combustion sensors in both industrial boiler and gas turbine tests. Although an acoustic sensor provided extremely fast combustion control in the gas turbine application, UCI suspects that the feasibility may be limited to specific situations. UCI recommends that further research be conducted to assess the performance of this sensor over a broad range of potential applications. UCI also identified the need for more research to enhance the user interface and other aspects of the combustion control system.

The results of this PIER-funded research project are encouraging and timely due to the current state of the electric industry in California. With deregulation, larger centralized power plants will compete with new smaller distributed power producing units. These power plants will likely be dispatched to follow local loads. Following these less diversified electricity demands might result in more cycling of power output level and the resulting combustion firing rate. If

harmful pollutant emissions are to be minimized, an automatic and optimized control system would be beneficial. This research provides the building blocks for such a combustion control capability under dynamic load conditions.

CIEE recommends that an important next step is to encourage both commercial burner and gas turbine manufacturers to collaborate with UCI in the further development and demonstration of these combustion control technologies.

APPENDIX I

TYPICAL EXAMPLE OF QUARTERLY PROGRESS REPORT

APPENDIX II

TYPICAL EXAMPLE OF QUARTERLY ADVANCE PAYMENT REQUEST WITH RECONCILIATION

APPENDIX III

CIEE STRATEGIC PLAN

APPENDIX IV

CIEE TESTIMONY ON EMERGING TECHNOLOGY INITIATIVE SUBMITTED TO CPUC

APPENDIX V

CIEE REQUEST FOR PROPOSAL

MARKET CONNECTIONS FOR NEW COMMERCIAL BUILDING TECHNOLOGIES

APPENDIX VI

FINAL REPORT OF 1999 CIEE TRIENNIAL REVIEW

APPENDIX VII

POTENTIAL SCOPE OF TECHNICAL ASSISTANCE AGREEMENT WITH CEC

APPENDIX VIII

Initial List of CIEE Technical Assistance Activities in Support of PIER Building Energy Efficiency Program

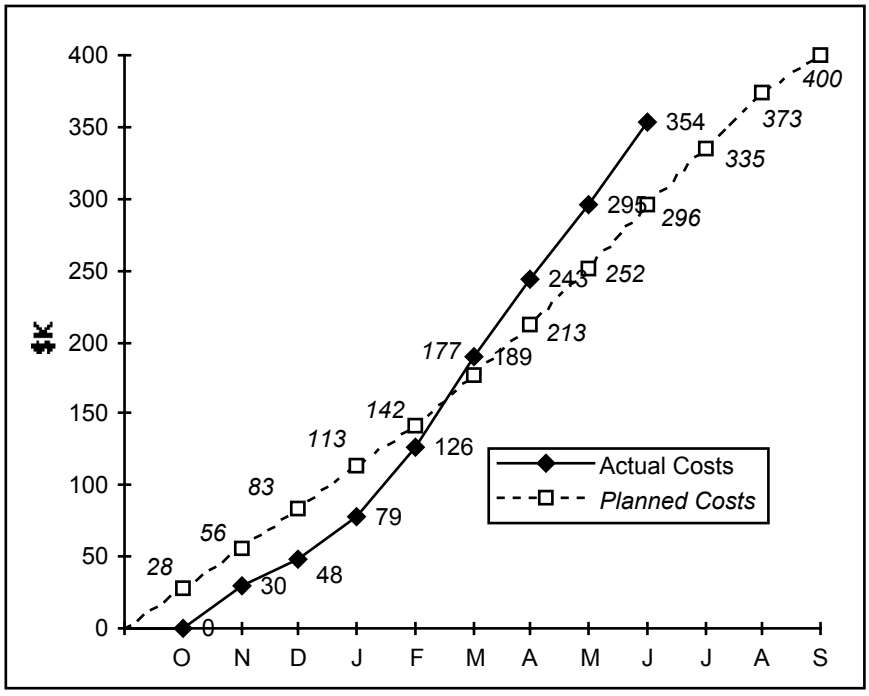
APPENDIX I

TYPICAL EXAMPLE OF QUARTERLY PROGRESS REPORT

CIEE/CEC PIER QUARTERLY STATUS REPORT
April through June 1999

Project Title: Project 4: Commercial Thermal Distribution Systems
Project Period: 1 October 1998 through 1 November 1999
Lead Investigator: Mark Modera, LBNL
Other Investigators: Ed Arens, UC Berkeley

Overview of Fiscal Status



Summary of What We Planned to Accomplish This Quarter

Field Testing of Duct-System Thermal Performance

- FIELD TESTING. Characterize four systems in the next quarter, including one large commercial building (an office) and three small systems. Thermal performance measurements will be made when the weather permits.
- LABORATORY TESTING. Test our facility for ELA measurement for large duct systems, and continue calibration of our new high-flow calibrated fan.
- ENERGY AUDIT. Communicate with the ACRx manufacturer and customize the equipment for energy audit in one small building system. Test the capacity and cycling characteristics of the cooling/heating equipment, and measure the short-term energy consumption and maximum electricity demand data for a small system in warmer month.
- FINAL REPORT. Conduct and summarize data analysis for the leakage characterization; complete and submit the final report.

Development and Testing of Aerosol-Injection Technologies

- LABORATORY TESTING. (1) Continue testing and improving our multi-point aerosol injection sealing system in the laboratory and in the field; (2) design experiments to better

understand the sealing process and increase the sealing rate; (3) design experiments to test and improve liner coating strategies while integrating field constraints.

- FIELD TESTING. Obtain permission for aerosol sealing of one additional building, and perform that sealing.

Energy and Equipment-Sizing Analysis of Air Distribution Systems

For next quarter, we plan to continue verification of the duct performance algorithms in DOE 2.1E. Once completed, we will evaluate the impact of duct leakage with respect to other prescriptive performance requirements that currently exist in the CALIFORNIA ENERGY COMMISSION non-commercial standards. The results will be used to develop a strategy for getting duct performance recognized within the CALIFORNIA ENERGY COMMISSION standard.

Diagnostic Protocols for Measuring Fan Performance and Evaluating Efficiency Measures

- Publish Phase III Final report.
- Complete preliminary CAV protocol, diagnostics, and data collection procedures.
- Complete VAV protocol development & alpha field-tests if possible.
- Begin implementation of web-based software.
- Complete final report on tracer gas airflow measurements. Begin development of functional specification in conjunction with Schiller Associates.

Summary of What We Actually Accomplished This Quarter

Field Testing of Duct-System Thermal Performance

In contrast with previous studies conducted by LBNL, our building selection this year was geared towards large-building systems. We conducted field characterization testing on five HVAC systems (or system sections) in five large commercial buildings, and on five HVAC systems in four small commercial buildings in northern California. To support this fieldwork we also designed and built a calibration facility for flow measurement, and a high-capacity fan pressurization system for measuring duct-system leakage areas and large register flows (up to 3000 cfm) in large systems.

SUPPLY DUCT ELA_{25}. For large systems, normalized leakage area (ELA_{25}) varied widely from system to system, ranging from 0.3 to 7.7 cm^2 per square meter of floor area served, and from 0.7 to 12.9 cm^2 per m^2 of duct surface area. Within the same VAV system, the normalized leakage areas of supply ducts (per unit duct surface area) varied by a factor of up to eight, indicating much tighter upstream ducts as compared to downstream branches. For small systems, the ELA_{25} ranged from 0.8 to 5.3 cm^2 per m^2 of served floor area, and from 3.7 to 7.5 cm^2 per m^2 of duct surface area. The averaged normalized ELA_{25} was 2.6 cm^2/m^2 floor area, somewhat lower than that found in our previous studies.

AIR LEAKAGE CLASS. For large systems, the air leakage classes for main supply ducts (upstream of VAV or mixing boxes) for all large systems tested ranged from 34 to 246, while those downstream (usually branches) varied widely from 58 to 606. In the present study, the total leakage class (supply, return, and air handler) of the small systems ranged from 244 to 414, averaging 333, once again lower than 447 average reported in LBNL's previous studies.

OPERATING PRESSURE. The average supply-plenum pressure observed in small commercial systems was 30 Pa, about 50 percent lower than the average found in the previous LBNL studies on small commercial buildings. The statistical significance of this difference is not convincing at this stage, since we only studied five such small systems. For large-building systems, we found large variations of operating pressures among different systems, and among different sections of the same systems. Duct sections or branches downstream of terminal boxes had average operating pressures similar to the operating pressures observed in the small-building systems.

AIR LEAKAGE FRACTIONS. In small systems, the average leakage fraction was 10 percent, considerably lower than the 26 percent average value reported by previous LBNL's studies. In large systems with terminal units (VAV or mixing boxes), it is necessary to separately characterize the leakage of sections that operate at different pressures, namely upstream and downstream of terminal units. Using two different methods in this study, the range of the estimated leakage fractions in two large constant-volume systems was estimated to be between 3 percent to 26 percent, a range similar to the findings in LBNL's previous study.

HEAT CONDUCTION LOSSES. We improved the accuracy of temperature measurements in the duct systems by employing Pro-HOBOs for this year's experiments. The effectiveness $((T_{register} - T_{room})/(T_{plenum} - T_{room}))$ for small-building systems ranged from 0.76 to 0.91, and the fractional on-time for cooling cycles in these buildings ranged from 14 percent to 48 percent during occupied hours. The average temperature rise between the outlet of the

cooling coils and the supply registers due to heat gains ranged from 1.2 to 2.4°C for the small-building systems. For large systems, the corresponding effectiveness was between 0.77 and 0.98 for the two CAV systems tested in heating mode, with temperature drop of up 4°C. As expected, the effectiveness decreased with the distance downstream of the supply plenum. For the one VAV system that we tested in cooling mode in a large building, the temperature rise ranged between 2°C and 12°C, which corresponds to an effectiveness of 13 percent to 94 percent.

Development and Testing of Aerosol-Injection Technologies

AEROSOL SEALING**.** The results of this year's aerosol sealing research can be divided into laboratory and field results. The key results in the laboratory were: 1) a characterization of the performance of two different nozzles and injectors, 2) design and outside construction of "compact particle injectors", 3) measurement of the failure pressure for aerosol seals, and 4) a comparison of the relative sealing times for two different leak geometries. For the nozzles and injectors, we characterized both the particle size distribution (with a newly modified measurement apparatus), and the fraction of particles lost to the plastic tubing surrounding the nozzle. These particle size distributions both allow us to better model the sealing process, and to choose the most efficient injection technique. One set of injectors that we characterized were "compact injectors", which are freestanding particle injectors that can be installed at different points throughout the duct system to increase the material injection and sealing rates. These injectors represent an important advance with respect to sealing duct systems in large buildings. Another important finding was that the aerosol seals are able to withstand very high-pressure differentials (6000 Pa or 24 in. H_20) before failing, which means that these seals will easily be able to withstand the pressures observed in commercial building duct systems. Moreover, failures were not catastrophic, with the broken seals sometimes "repairing" themselves when the pressure differential was taken away. Finally, we found that the sealing process was approximately three times faster for "joint"-type leaks, as compared to "hole"-type leaks, suggesting that our sealing process may be considerably faster in actual systems, as compared to what our current model (based on hole-type leaks) suggests.

We also performed two field experiments with aerosol sealing in two large-commercial buildings. We found that sealing rate increased considerably when the compact injector was used, and that adding an opening in the downstream section of the duct at allowed us to continue the sealing process after the threshold limit value for the duct pressure (500 Pa with the present apparatus) was reached. The leakage classes of the systems (or sections) were reduced from 657 down to 40, and from 40 down to 3, corresponding to leakage reductions of more than 90 percent based on the leakage area per unit of duct surface area.

AEROSOL COATING. Our research on aerosol coating this year resolved a number of key issues, including: 1) the issue of whether we can create an impermeable membrane remotely, 2) the development of tools to quantify the relative flow resistance of different parts of the liner, and 3) an estimation of the energy savings potential associated with creating an impermeable membrane. Concerning the first, we were able to create impermeable membranes on liners from as much as 15 ft away, which is a significant breakthrough. We also developed an apparatus for quantifying the flow-resistance uniformity of the membrane created. This device was used to demonstrate that the membrane created was rather uniform with respect to airflow resistance.

The issue of quantifying the energy saving potential of creating an impermeable liner membrane provided a less encouraging result. In particular, the high duct velocities that cause the degradation of porous-insulation performance also result in relatively short residence times in the ductwork. This means that even though we can achieve significant improvements in insulation R-value at high velocities, the absolute savings are relatively small. The reductions in fan power due to the improvement of the R-value of the insulation is on the order of a few percent, and the overall savings, including the impact of the membrane on flow resistance is not likely to be more than 10 percent of fan power. On the other hand, since there is already an industry that is applying "permeable" coatings to the inside of duct liners for IAQ purposes, this technology could prove to be an important augmentation of their service, creating a better barrier to future particle and microbial depositions in the liner, and providing the energy savings at a low incremental cost.

Energy and Equipment-Sizing Analysis of Air Distribution Systems

The objective of this effort was to outline a strategy for recognizing duct performance within the California Energy Commission (Commission), Title-24, Non-Residential Building Energy Standards. At the outset of this effort we first found that: 1) the impacts of duct performance are essentially not considered in the California non-residential standards, and 2) the DOE-2.1E building simulation program plays an important role in the evaluation of California non-residential compliance. This meant that much of this effort revolved around investigating how DOE 2.1E treats, and can be made to treat duct performance.

At first glance, it appears that DOE2.1E addresses duct losses, and that the incorporation of duct losses would be relatively straightforward. Unfortunately, this optimism was not borne out by our detailed analyses. In brief, although DOE-2 does include the basic capabilities for modeling duct leakage and heat loss in supply ducts, there are a number of hurdles to be overcome. Some salient issues include:

- The lack of an algorithm for return duct losses/gains;
- The use of a fixed, supply-duct leakage fraction, even for VAV systems;
- A ponderous set of keyword choices that can easily derail even the most conscientious, skilled and motivated user of the program;
- A number of hardwired assumptions about the implications of duct losses on building and plenum-zone loads and temperatures.

We made a number of comparisons between DOE-2 results and our best estimates of the impacts of duct performance, and found significant discrepancies. Although we seem to have explanations for most of the discrepancies, additional digging within the DOE2.1E program will be needed to obtain a roadmap for addressing duct performance in an accurate and straightforward manner.

On the positive side, commercial vendors of non-residential compliance tools were supportive of these efforts, and seemed to be willing to implement our ultimate strategy, assuming that it is practical. Since the tools available use DOE-2.1E as the calculation engine, they can tap into the existing duct performance modeling capabilities offered by the program, and ultimately into our improvements.

Finally, incorporating duct-modeling capabilities into compliance tools is only one aspect of the changes that need to be made to the non-residential standards. Other issues that must be addressed and resolved before duct performance can be accounted for include: 1) definition of duct condition in the standard building, 2) development of ACM compliance tests for evaluating duct performance, 3) documentation of the impact of duct efficiency measures in actual buildings, and 4) demonstration of consistency between simulated duct performance impacts and actual impacts.

Diagnostic Protocols for Measuring Fan Performance and Evaluating Efficiency Measures

PHASE III FINAL REPORT. The draft report was updated and comments incorporated.

PROTOCOL AND DATA COLLECTION PROCEDURES. Development of the diagnostics protocols continued. Additional methods for presenting results to facilitate diagnosis continue to be explored. CAV and VAV protocols were combined into a unified methodology. Software diagnostic tools were finalized.

WEB-BASED SOFTWARE. Design and a preliminary implementation of the web-site software were completed.

TRACER GAS AIRFLOW. Due to time and budget constraints assistance from Schiller associates did not occur. An outline for the functional specification was completed.

Papers and Reports

We submitted an outline and executive summary of our interim report to CIEE/Commission on June 30, and will submit the interim report by July 31.

Significant Problems or Changes

Progress and expenditures will result in project being completed on time and within budget. A no-cost extension through 1 November 1999 was given on the contract to allow staff to prepare for and attend the California Energy Commission/PIER Conference in October 1999. This will not affect the deliverable date for the final report. A revised Exhibit B for the project is attached.

What We Expect to Accomplish during the Next Quarter

The coming quarter will involve revisions and refinements of the final report for this project, as well as a few additional thermal performance and equipment-performance measurements funded by DOE. Our major accomplishment will be the completion of the final report.

APPENDIX II

TYPICAL EXAMPLE OF QUARTERLY ADVANCE PAYMENT REQUEST WITH RECONCILIATION

QUARTERLY COST REPORT for KEY PERSONNEL

Project Identification No. 500-97-013

Project Title: Project 4: Commercial Thermal Distribution Systems

Project Term: 1 October 1998 through 1 November 1999

Quarter Being Reported: 1 April 1999 to 30 June 1999

	(A)	(B)	(C)	(D)	(E)	(F)			
	Percent Time	Labor Rate	Months/ Hours Billed This Qtr	Total Direct Labor (A*B*C)	Fringe Benefits	Total Cost, Current Quarter (D+E)	Cum Costs To Date	Approved Costs on Project	% of Budget Spent To Date
M. Modera, LBNL	25%	8,562 /mo	3	6,328	1,089	7,417	19,115	24,772	77%
E. Arens, UCB	25%	10,547 /mo	0	0	0	0	0	2,880	0%

Comments:

APPENDIX III

CIEE STRATEGIC PLAN

DRAFT CIEE STRATEGIC PLAN (1/6/2000)

Purpose of this Plan

- To provide guiding strategies and some specific goals for bringing CIEE through the changes consequent to the restructuring of California's electricity industry in a way that maximizes our contribution to California's public interest RD&D program.

CIEE's Mission

- To be an effective, world-class organization for planning and managing public interest RD&D that leads to the development and application of new end-use efficiency technologies that provide California consumers with affordable, high quality energy services and contribute to a sustainable future.

The Situation

- Utility restructuring has profoundly affected the environment for CIEE. Although SCE and PG&E remain on the Board, they are no longer making member contributions because most of their public interest R&D has been supplanted by the Legislatively mandated Public Interest Energy Research (PIER) program. The other utilities on the Board, SMUD and SCG, are continuing to make member contributions.
- The PIER program, which is being managed by the CALIFORNIA ENERGY COMMISSION, is not now providing any funds to CIEE. However, discussions with the CALIFORNIA ENERGY COMMISSION are continuing concerning a role for CIEE in the PIER program.
- State legislation has also mandated an energy efficiency program. The more than $200 million/year allocated for this program will be administered by the investor-owned electric utilities through 2001.
- At the end of 1999 the PG&E and SCE energy efficiency programs funded several CIEE market transformation projects. Approximately $3 million was placed under CIEE management using the supplemental funding mechanism in the CIEE Management Plan.
- We have the opportunity to make a significant contribution to the new public interest RD&D program and the energy efficiency program, helping to produce results that will convince the CPUC and the Legislature to continue these programs beyond 2001.
- To be successful, we must continue to identify and make the changes necessary to establish an appropriate role for CIEE in this new environment.

CIEE Strengths

- We have a ten-year track record of successful planning and management of a high-quality, high-impact research program. This program has results "in the pipeline" that can help to demonstrate the value of public interest R&D to the Legislature and the CPUC in the near term. Because of the transition funding from the PIER program, our research program has maintained its momentum.
- We have developed an effective systems approach to problems in end-use energy efficiency. This is different from and usually more effective than the usual device-oriented approach. The systems approach continues to offer many opportunities to develop new knowledge and end-use efficiency technologies.
- Our partnership between the University, government agencies, utilities, industry and other stakeholders is a "going concern." The considerable effort needed to build an organization and establish a network of relationships has already been made. This partnership is a very effective mechanism for pooling resources to support R&D on end-use efficiency. The

partnership's emphasis on connecting R&D to the market through public/private cooperation is appropriate for the times.

- We have a flexible, highly qualified, competent and motivated core staff.
- Moving the administrative responsibility for CIEE to the UC Office of the President has reduced the costs and increased the flexibility of CIEE operations.
- We can draw easily on the resources of the University and its laboratories to get world-class technical advice and assistance.

Weaknesses and Constraints

- We have not been effective in explaining our accomplishments or the potential impacts of our research program.
- Instability in the funding for CIEE is making it difficult to support multi-year research efforts, which are an essential component of an effective research program.
- Administrative mechanisms for working with the PIER program are cumbersome and, on occasion, a source of contention.

Opportunities

- Our core competencies of planning and managing public interest R&D can complement the efforts of the California Energy Commission staff. Our experience using the research capabilities of California's universities and affiliated laboratories and our demonstrated ability to link these capabilities with private partners can help to integrate a vital part of California's R&D infrastructure into the PIER program.
- The State's public-interest energy efficiency program is a natural client for the PIER program's results. However, the link between the energy efficiency program and the PIER program is very weak. Our established partnership can be a venue for cooperation and coordination among the organizations that are responsible for these programs.
- We can also provide a venue for cooperation and coordination among organizations with public interest R&D programs. In addition to the PIER program, other organizations with public interest R&D programs that are represented on CIEE's Board as members or advisors are municipal utilities, natural gas utilities, the Gas Research Institute, the Electric Power Research Institute, and the US DOE. By working with these organizations we can provide leverage to each of them while increasing the overall impact of California's public interest R&D efforts.

Threats

- Since the California Energy Commission is also engaged in planning and managing public interest R&D, we may be seen by some to be superfluous. We have not yet been persuasive in making the case that CIEE will be an effective complement to California Energy Commission efforts. We are not a substitute or a competitor.
- There is a potential for some of our constituency in the research community to become our competitors. This will depend on how the PIER programmatic RFPs are formulated. We are planners and managers. If the programmatic RFPs include research performance in addition to planning and management, then some research performers will probably apply for programmatic funding.

Guiding Strategies

- Rely on core competencies to maintain high-quality, high-impact program

- Communicate our management abilities and research accomplishments effectively
- Strengthen relationships with our partners
- Be flexible and adaptable so we can maximize our contribution to the PIER Program

Four Initiatives

- Technical support for PIER. Based on conversations with California Energy Commission staff, we believe that our assistance would be welcomed by the buildings element of the PIER program. The components of a technical support relationship need to be developed, but they could include many of the planning and management activities that CIEE now conducts. Ideally, the relationship will evolve into a partnership between the California Energy Commission and UC that takes full advantage of the complementary skills of the two organizations. A specific goal for this initiative is, before the end of the first quarter of 2000, to establish an interagency agreement with the California Energy Commission for technical support and begin providing services to the PIER buildings' research program
- Coordination for public interest R&D programs. The public interest R&D programs of the investor-owned electric utilities have largely been replaced by the PIER program, but other utilities in California are continuing to conduct public interest R&D. Of particular importance to CIEE are the SMUD and SCG programs. We must earn the continued support of these utilities by exploiting opportunities to enhance their programs by fostering collaborations with the California Energy Commission and other organizations (GRI, EPRI and DOE) and with the public interest energy efficiency program. A specific goals for this initiative are, before the end of the first quarter of 2000, (1) in Sacramento, initiate a phase of the CIEE multi-year project on the integrated monitoring and diagnostics system (IMDS) and (2) work with SCG to establish a more coherent public interest research program on topics related to the energy efficient and environmentally-attractive utilization of natural gas.
- Emerging technologies and market transformation. There is widespread agreement that there should be stronger links between the public interest R&D and energy efficiency programs. One place these links can develop is in the "emerging technologies" component of the energy efficiency program. The emerging technologies component, although not yet fully defined, is intended to contribute to market transformation by supporting technologies that are on the verge of commercialization. It will involve both demonstration projects and refinement of technologies. It is an area where the continuing assistance of researchers is still needed for success. The recent decision that utilities will administer the energy efficiency program through 2001 and our established relationship with the research community gives us the opportunity to work with the utility members of our Board to make CIEE a venue for the development of emerging technology programs. The potential for this area is demonstrated by the supplemental funding that CIEE received at the end of 1999. A specific goal for this initiative is, before the end of the first quarter of 2000, to initiate quickly and efficiently the market transformation projects that were funded at the end of 1999 by PG&E and SCE.
- Exemplary Buildings. California State organizations including the University of California are initiating efforts to increase the energy efficiency of new buildings. The purpose of these efforts is both to reduce the costs of operation and to provide an example of sustainable design and construction that others can follow. At the same time, the utility-administered

energy efficiency programs are considering how they can support the construction of exemplary buildings. The buildings research community has substantial technological and knowledge resources that could contribute to the success of such efforts. There is an opportunity for CIEE to provide focus for these resources in meeting the energy efficiency goals of exemplary buildings. A specific goal for this initiative is during 2000 to assist UC in developing a plan for its UC Merced campus that will exemplify UC's commitment to environmental stewardship.

APPENDIX IV

CIEE TESTIMONY ON EMERGING TECHNOLOGY INITIATIVE SUBMITTED TO CPUC

BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking on the Commission Proposed Policies and Programs Governing Energy Efficiency, Low-Income Assistance, Renewable Energy and Research Development and Demonstration	)))))	R.98-07-037

COMMENTS OF THE UNIVERSITY OF CALIFORNIA ON THE JULY 1, 1999 DRAFT DECISION OF ADMINISTRATIVE LAW JUDGE GOTTSTEIN: INTERIM OPINION – PROGRAM YEAR 2000 SELECTED POLICY, PROGRAM AND FUNDING MODIFICATIONS

Dian M. Grueneich, J.D.
Jody S. London
Grueneich Resource Advocates
582 Market Street, Suite 1020
San Francisco, CA 94104-5808
(415) 834-2300: Telephone
(415) 834-2310: Facsimile

For The University of California
July 20, 1999

I. SUMMARY

The University of California (UC) is pleased to submit comments on the Draft Decision of Administrative Law Judge Gottstein on Program Year 2000 and 2001 energy efficiency programs. As stated in our June 7, 1999, comments on the recommendations of the California Board for Energy Efficiency (CBEE), the UC is concerned with not only existing energy efficiency technologies but with development and commercialization of new technologies – an area known as "emerging technologies." While the CBEE and Draft Decision recommend necessary first steps, the UC believes the Final Decision should establish a formal process for developing an integrated, systematic and strategic approach to emerging technologies. Our comments on the draft decision address two main points:

- The California Public Utilities Commission (Commission) should initiate development of a statewide strategic plan for emerging energy efficiency technologies that draws on the resources of interested stakeholders, including the Commission, the CBEE, the California utilities, and the California Energy Commission (CALIFORNIA ENERGY COMMISSION). Without such an approach, significant lost opportunities will occur, resulting in the loss of significant energy and cost savings to California ratepayers.
- The Commission should utilize the resources of the UC's California Institute for Energy Efficiency (CIEE) in developing a strategic plan for emerging technologies. The CIEE is uniquely situated to provide assistance, as its mission is to plan and manage a statewide program of research and technology development aimed at advancing end-use energy efficiency and productivity in California.

Furthermore, the UC continues to believe that success in this area will require additional funding specifically devoted to emerging technologies, and we urge the Commission not to foreclose this approach.

II. UC CONCERNS AND RECOMMENDATIONS

A. Background

The UC has been an active participant in energy efficiency planning activities. It participated in the public workshop on PY 2000 and PY 2001 planning held by the CBEE on April 6, 1999. In that workshop, the UC recommended to the CBEE that more resources be devoted to funding energy-efficient emerging technologies in market transformation programs for PY 2000 and PY 2001.

During this workshop, the UC also recommended that stronger ties be developed between the research, development and demonstration (RD&D) activities being funded by the California Energy Commission's Public

Interest Energy Research (PIER) Program and the market transformation programs being funded by the Commission's Energy Efficiency Public Goods Charge Program. Stronger ties are needed because the energy efficiency products and services offered by the research community should be placed into the marketplace (via market transformation programs) as soon as possible to maximize public benefits and because the research needs encountered in the implementation of market transformation programs should be addressed by the research community in a timely fashion. Finally, we recommended that a more integrated, systematic, and strategic approach be taken to promoting emerging technologies in California. At this workshop, the California Energy Commission seconded our concerns and supported our recommendations.

In its May 12, 1999 filing, the CBEE recommended that the Commission adopt six selected policy, program and funding changes for the PY 2000 and PY 2001 programs. The CBEE's May 12 filing did not mention emerging technologies.

In its June 7, 1999 filing, the UC responded to the CBEE's recommendations by requesting that the Commission:

1. Request the CBEE implement a process to develop a more integrated, systematic, and strategic approach to emerging technologies, including conduct of a workshop within 60 days of the Commission's decision;
2. Utilize the resources of the CIEE to assist CBEE in developing a more integrated, systematic and strategic approach to emerging technologies; and
3. Direct $2 million of PY 1999 carry-over funds be used to support emerging technologies and a more integrated, strategic approach.

In its June 14, 1999 filing, the CBEE responded to the UC's comments by noting that the CBEE supports emerging technologies, as reflected in its overarching program recommendations (subsequently adopted by the Commission in Resolution E-3592) and policy rules (specifically, policy rule IV-8 which directs coordination of programs with the California Energy Commission's PIER program). Furthermore, the CBEE agreed that: (1) emerging technologies are an activity that may warrant attention, (2) there appeared to have been little coordination of utility efforts to promote emerging technologies, and (3) entities such as the CIEE could play a valuable role in fostering greater coordination. However, the CBEE concluded that the current planning process and program budgets were deemed to be adequate for promote emerging technologies and recommended to the Commission that the UC's request to set-aside $2 million for a specific program on emerging technologies be denied. In addition, the CBEE recommended that the Commission direct the utilities to address explicitly in their compliance applications the role of emerging technologies in their programs, including the coordination of these activities with the other utilities and the California Energy Commission and consideration of a more formal role for the CIEE.

In her July 1, 1999 draft decision, the ALJ essentially endorsed the recommendations of the CBEE without further discussion.

B. Ongoing UC Concerns

UC is encouraged by the positive support given to the promotion of emerging technologies by the CBEE and the ALJ. However, we believe that one of our major issues (the need for a more integrated, systematic and strategic approach to emerging technologies) was not addressed by the CBEE and the ALJ. It appears that CBEE and the ALJ assume that having utilities "address explicitly in their compliance applications the role of emerging technologies in their programs, including the coordination of these activities with the other utilities and the California Energy Commission and consideration of a more formal role for CIEE," (Draft Decision, pp. 23-24) will automatically lead to a systematic and statewide approach. We are not so sanguine, given historical practice. (We recognize, however, that the ALJ proposed directive may constitute an important step in a longer-term planning process). After attending CBEE briefings (June 30 and July 13) on emerging technologies, it became quickly apparent that an integrated, systematic strategy is sorely needed due to the following concerns:

1. The definition of emerging technologies may vary from one utility to another.

2. There is very little coordination among utilities in selecting and promoting emerging technologies. There is no statewide strategic vision for the selection and deployment of emerging technologies in market transformation programs.

3. The utilities no longer have specific programs on emerging technologies. Emerging technologies are scattered throughout utility programs in the residential, non-residential, and new construction areas. (Prior to 1999, some utilities had programs specifically targeted to emerging technologies).

4. Utility projects on emerging technologies are not fully coordinated with emerging technology projects funded by other organizations: e.g., the U.S. Department of Energy, the Gas Research Institute, the Electric Power Research Institute, the CIEE, and California Energy Commission's PIER Program (and vice versa).

5. Opportunities for collaboration among utilities and other stakeholders, in California as well as outside California, exist but have not been exploited to their full potential.

As noted above, the recommendations of the CBEE and the ALJ are necessary first steps but are not sufficient. Accordingly, we request that the Commission redress this situation by establishing a formal process for developing an integrated, systematic and strategic approach to emerging technologies.

C. UC Recommendations

UC specifically requests the Commission direct implementation of the following recommendations in addition to those stated in the draft ALJ decision:

1. Adopt a More Integrated, Systematic, and Strategic Approach to Emerging Energy Efficiency Technologies

The UC recommends that a more integrated, systematic, and strategic approach to emerging technologies be implemented immediately. The UC recommends that the Commission request the CBEE (possibly using the CIEE, as described below) implement a process for developing a more integrated, systematic, and strategic approach to emerging technologies. At a minimum, a workshop should be held within 90 days after the Commission issues its final decision. At this workshop, interested stakeholders can participate in developing a strategy for: promoting emerging technologies in the PY 2000 and 2001 programs; integrating RD&D into market transformation programs; and forging stronger links between the California Energy Commission's PIER Program and utility market transformation programs. It is expected that the strategy would result in the preparation of a strategic plan that would be updated regularly. The strategic plan would include at a minimum the following components (reflecting the concerns described above):

1. A definition of emerging technologies agreed to by all stakeholders.
2. A process (or processes) for selecting emerging technologies in market transformation programs.
3. A process (or processes) for implementing emerging technologies in market transformation programs.
4. A current list of emerging technologies being promoted in market transformation programs.
5. A measurement and evaluation system for measuring and tracking the progress and performance of emerging technologies.
6. A process for transferring the results of market transformation projects to the design and development of research projects that address key barriers confronting the commercialization of emerging technologies. Examples include workshops, Web pages, list servers, brochures, special reports, etc.
7. A process for promoting collaboration on emerging technologies with other organizations (in California and outside California).

8. An assessment of the amount of funds currently being spent on emerging technologies and an assessment of the amount of funding needed on emerging technologies.

Based on the results of this workshop, the Commission should consider whether to set aside additional funding specifically for emerging technologies.

2. Utilize the Resources of the California Institute for Energy Efficiency

As reflected in the CBEE's May 12 and June 14 filings, as well as in the proposed work that it is scheduled to develop, we are concerned that the CBEE will not be able to devote the necessary resources and attention to the promotion of emerging technologies as envisioned in our first recommendation. We expect the CBEE and the utilities to be spending most of their time on the refinement of existing programs without providing sufficient time to emerging technologies.[1]

We therefore recommend that the Commission and CBEE use the CIEE to aid in the development of a more effective emerging technologies program. The Commission should also consider using the CIEE, as it has in the past, as a mechanism for pooling funds to conduct emerging technology projects. As noted in our June 7 filing, the CIEE's mission is to plan and manage a statewide program of research and technology development aimed at advancing end-use energy efficiency and productivity in California. The CIEE has an administrative structure that can be effectively utilized to assist CBEE in developing a more integrated, systematic, and strategic approach to emerging technologies. Since 1990, the CIEE, using funds provided by California utilities at the direction of the CPUC, has demonstrated the ability to coordinate and implement a statewide program of research and technology development aimed at advancing end-use energy efficiency and productivity in California. As part of R&D efforts, researchers have collaborated with the CIEE's utility sponsors and California's energy services industry in field-testing, transferring, and commercializing promising technologies. By developing a network of researchers and potential users of emerging technologies (including the establishment of contractual mechanisms across multiple institutions), the CIEE has been able to successfully demonstrate its capacity and ability to conduct research and development on emerging technologies and help bring these technologies into the marketplace. Finally, the CIEE's

[1] Another possibility might be the Commission's Energy Division. However, we have similar concerns regarding resources and attention, because the Division is assuming more responsibilities in assisting the CBEE.

Research Board and Planning Committee help to foster joint planning by stakeholders and collaborative funding of RD&D and market transformation on emerging technologies.

The UC recommends that the Commission direct CBEE to work with the CIEE and use CIEE resources to develop a statewide strategy and plan for promoting energy-efficient emerging technologies in market transformation programs. The information resulting from these activities will be used to improve the design and implementation of energy efficiency market transformation programs.

CONCLUSION

The UC appreciates this opportunity to respond to the ALJ's draft decision. We look forward to the Commission's ruling on this matter.

Respectfully submitted,

Dian M. Grueneich, J.D.
Jody S. London
For the University of California

Dated: July 20, 1999

APPENDIX A
PROPOSED FINDINGS OF FACT AND CONCLUSIONS OF LAW

FINDINGS OF FACT

22. It is ~~premature~~ *appropriate* to establish a funding set-aside for emerging technologies ~~until more is know about~~ *given* the current role and opportunities for emerging technologies in the utilities' programs.

23. *The University of California's California Institute for Energy Efficiency (CIEE) has as its mission to plan and manage a statewide program of research and technology development aimed at advancing end-use energy efficiency and productivity in California.*

CONCLUSIONS OF LAW

8. In their compliance applications, it is reasonable the utilities address the role of emerging technologies in their programs, including the coordination of these activities with other utilities and the CERC. *CBEE and* ~~T~~*t*he utilities *should provide* ~~may also consider~~ a more formal role for the California Institute for Energy Efficiency, as long as it is consistent with our determination that the utilities, not other entities, continue as program administrators for energy efficiency through December 31, 2001.

ORDERING PARAGRAPHS

14. In their compliance applications, the utilities shall address the role of emerging technologies in their program, including the coordination of these activities with other utilities and the CEC. *CBEE and* ~~T~~*t*he utilities *should provide* ~~may also consider~~ a more formal role for the California Institute for Energy Efficiency, as long as it is consistent with our determination that the utilities, not other entities, continue as program administrators for energy efficiency through December 31, 2001.

~~15. In their compliance applications, the utilities shall address the role of emerging technologies in their program, including the coordination of these activities with other utilities and the CEC. The utilities may also consider a more formal role for the California Institute for Energy Efficiency, as long as it is consistent with our determination that the utilities, not other entities, continue as program administrators for energy efficiency through December 31, 2001.~~

15. The CBEE, working with the CIEE, should implement a process for developing a more integrated, systematic, and strategic approach to emerging technologies. Within 90 days of the effective date of this decision, a workshop should be held at which interested stakeholders can participate in developing a strategy for: promoting emerging technologies in the PY 2000 and 2001 programs; integrating RD&D into market transformation programs; and forging stronger links between the California Energy Commission's PIER Program and utility market transformation programs.

APPENDIX V

CIEE REQUEST FOR PROPOSAL

MARKET CONNECTIONS FOR NEW COMMERCIAL BUILDING TECHNOLOGIES

SOLICITATION OF PROPOSALS

Market Transformation Research:
Market Connections for New Commercial Building Technologies

CALIFORNIA INSTITUTE FOR ENERGY EFFICIENCY

DUE DATE: 12 MARCH 1999

I. INTRODUCTION

The University of California has established the California Institute for Energy Efficiency (CIEE) as a statewide research organization administered by the University of California Office of the President (UCOP). CIEE sponsors R&D on end-use efficiency; this work is conducted primarily by investigators at California's public and private colleges, universities, and university-affiliated laboratories and research centers that operate within California. From 1990-97, CIEE's annual research budget of approximately $3.5 million was funded primarily by California's electric and natural gas utilities; continued funding is being provided in 1998 by several utilities and by the Public Interest Energy Research (PIER) program administered by the California Energy Commission (CEC).

In cooperation with the CEC, CIEE developed this solicitation through a scoping process designed to identify a research agenda addressing market connections for new technologies. The scoping effort, which is still under way, is identifying several promising areas, the first of which is focused on the market for new commercial buildings. The report for this initial effort "New Commercial Buildings—Market Transformation Research Needs," can be found at <http://eetd.lbl.gov/CIEE/scoping>. Each of the research areas is expected to support CEC emphasis on market connections in the creation of new knowledge and technology through PIER. The research will also contribute to the theory-based approach for market transformation being developed by the Commission.

Eligible California institutions are invited to submit proposals to perform the tasks described in the attached scope of work. This Request for Proposals covers Phase I of what is anticipated to be a multiyear project on the topic of market transformation research for new commercial buildings. The results of Phase I will be used in part to determine the scope of research topics in future phases.

Phase I is expected to require 24 to 36 person-months of effort. Researchers must complete work within 9 to 15 months of the contract start date, with 3 additional months allowed for report review and finalization. Up to $325,000 may be available for this phase of the project.

Interested researchers may direct their technical and contracting questions by e-mailing CIEE's Contract Administrator, John Snyder, at **JLSnyder@lbl.gov**. Questions must be received by 11:59 pm PST, 29 January 1999; questions received after that time may not be addressed or considered. Responses will be made no later than 12 February 1999, and will **only** be posted at: <http://eetd.lbl.gov/CIEE/questions>. Example copies of the general contract terms and conditions used by CIEE can be obtained by pointing your browser to: <http://eetd.lbl.gov/CIEE/terms>, or will be sent upon request**.**

PROPOSAL SUBMISSION PROCESS

The original (**with official signatures from the proposer's Contract/Grant officer)** and seven copies of the proposal, plus an electronic copy on a 3.5″ disk in Microsoft Word, should be sent to:

RFP No. CIEE 98-1
John Snyder, Contract Administrator
Mail Stop 90-3026
University of California
Lawrence Berkeley National Laboratory
One Cyclotron Road
Berkeley, California 94720

Proposals must be received at CIEE **no later than 5:00 pm PST, Friday, 12 March 1999.** Faxes or electronic mail submittals are **not** acceptable. All proposals received contrary to these instructions **will be returned without consideration.** Proposals will be kept confidential by CIEE.

III. SELECTION PROCESS

A. Eligibility for Proposal Submission

The following institutions are eligible to submit proposals for funding under this Request for Proposals:

- All public and private California colleges and universities.
- Those laboratories and/or research centers that are affiliated California colleges or universities and that are located in California, such as the UC-operated national laboratories.

These eligibility conditions do not preclude the submission of a proposal from an eligible institution which includes subcontracts with non-eligible organizations (including organizations from outside California), provided that (1) there is demonstrated necessity for their involvement (e.g., unique capabilities or facilities), (2) the Lead Principal Investigator (PI)

is from an eligible institution, and (3) a significant part of the research is conducted by eligible institutions (at least 25 percent of the funding).

Multi-investigator proposals are expected, and multi-institution proposals will be considered up to a maximum of four institutions, including major subcontractors. Such proposals must identify a Lead PI; this individual will have primary responsibility for assuring that the work is completed and delivered in a timely fashion. Subcontracting institutions may have a PI designated as a co-lead for the project. Awards to non-lead project team members may be made via subcontracts issued by the lead institution or as separate subcontracts issued by CIEE, at CIEE's discretion. The lead institution will be responsible for the performance of work on any subcontracts it issues, and will provide copies of all subcontracts to CIEE.

B. Evaluation Process

1. Proposals received by the deadline for submission will first be reviewed to determine if they were submitted by an eligible institution, as described in Section III.A. Proposals submitted by non-eligible institutions will not be reviewed further and will be destroyed.
2. For proposals which include a subcontract to a non-eligible institution, the "Justification for Subcontract to Non-Eligible Institution" (Section IV below) will be reviewed to determine if the participation of the non-eligible institution meets the requirements described in Section III.A above. Proposals that do not meet this requirement will not be reviewed further and will be destroyed.
3. The remaining proposals will be evaluated and ranked by a review panel using the criteria listed in Section III.C. This ranking is subject to final review by the CIEE Director.
4. If at least one of the proposals is scored high enough to meet CIEE's needs, CIEE will enter into contract negotiations with the institution submitting the highest ranking proposal.

C. Evaluation Criteria

The following criteria will be taken into consideration when evaluating and selecting a proposal. They are listed in order from the most to least important. The information, which must be provided in order to make the evaluation, is described in Section IV below.

1. Researchers' experience and qualifications. Principal Investigator-level expertise in multiple disciplines of economics, sociology and other relevant behavioral sciences is considered crucial for the success of the project.
2. Technical approach. This criterion emphasizes the probability that the proposed research approach and methodology will address the goals of the first project phase and will contribute to the eventual success of the overall project as described in the attached Scope of Work, given the available budget for Phase I. Factors to be considered include clarity and definition of proposed tasks, as well as demonstrated awareness of prior relevant research.
3. Special facilities, sources of information, databases, tools, and equipment.
4. Appropriateness of the budget in relation to the proposed research.

IV. FORM AND CONTENT OF PROPOSALS

Text may be double or single-spaced, with readable type. Pages are to be numbered. Margins should be a minimum of 1 inch. The document may be single- or double-sided, and may be either stapled or bound. Please check the text for spelling. Proposals are to be organized as set forth below:

Cover page. Use the form attached (or a photocopy), one page per institution/ organization. The form MUST be signed by an institutional representative who is authorized to negotiate and approve contracts on behalf of your organization.

Technical Discussion: Proposers should address Evaluation Criteria 2 and 3 from Section III.C. above. Proposers should discuss their proposed methodology for accomplishing Tasks 1 through 3 described in the attached Scope of Work, and should explain in detail how the proposal will address the goals of the project phase and contribute to the success of the overall project. The discussion should include a description of what sources of information and data will be used and how this information will be evaluated, as well as any special tools, equipment, or facilities researchers propose to use to accomplish the project tasks.

Qualifications: This section should address Evaluation Criterion 1 in Section III.C above. Describe the relevant qualifications and experience of the Principal Investigator(s) and each senior member of the research team in terms of the overall project: general knowledge and experience that cross-cuts the primary and potential future subject areas, ability to participate as a member of a multi-investigator team, and any other factors that demonstrate the PI's potential to contribute to the project as a whole. Relate any experience with integration activities and collaborative projects. Include a curriculum vitae for the PI(s) and each senior team member. Briefly describe any relevant prior research by the team members; include references to relevant publications. Include a discussion of related research currently being conducted or planned by the PI(s), and how it would complement work to be done under this solicitation. Discuss any time and other constraints on the availability of the PI(s) and key support staff.

Justification of Subcontract to Non-Eligible Institution (if applicable): If the proposal includes a subcontract to a non-eligible institution, describe the subcontractor's unique capabilities or facilities, which justify their participation on the project team. Describe which parts of the research will be conducted by the subcontractor and which will be conducted by the proposing institution.

Detailed Budget: Use the enclosed format and instructions in Section V. Note that CIEE requires that researchers meet up to four times per year with a Project Advisory Committee, and that researchers attend CIEE's annual conference or an equivalent activity. CIEE also requires that investigators submit 50 copies of their final report. As described in the budget preparation instructions, adequate funds to cover costs associated with these activities should be included.

V. BUDGET PREPARATION INSTRUCTIONS

Submit your budget in accordance with the attached format (you may use your own spreadsheet); please double-check your figures before submission.

NOTE: It is CIEE's policy not to pay for general-purpose office equipment (such as computers or printers) or software as a direct cost; procurement of such items must be justified in terms of their specific relevance to the project, and must be pre-approved in writing.

The following information is REQUIRED:

A. Name and title of all senior research personnel; category of support personnel (e.g., technician, graduate student, administrative assistant). Show effort level (e.g., FTEs, work-months), rate, and cost for each individual. Show academic year and summer rates separately (e.g., "Student, summer" and "Student, academic year"). Certify on Explanation page that salaries proposed are net salaries which do not include any fees, overheads or other direct or indirect costs (i.e., that they are wages actually to be paid to individuals), or, if providing ranges, include a copy of ranges or categories published by your institution.

B. Fringe benefits: Show rate and base to which rate applies. If different rates apply, show separately and discuss on Explanation page.

C. Total salaries and wages (A + B).

D. Subcontracts and Consultants: On Explanation page, identify each subcontractor or consultant and provide a one-sentence description of work. For each consultant or subcontract under $10,000, provide estimated level of effort (e.g., hours or days) and rate charged. For any subcontract over $10,000, attach a complete budget following the format given here.

E. Equipment: Equipment is any item costing $5,000 or more and having a useful life of two years or more. On the Explanation page, identify each piece of equipment to be purchased and its estimated cost. Items must be necessary and specific to the proposed research.

F. Travel: For *each* anticipated trip, give *specific* information on destination, estimated air fare/transportation costs, lodging/per Diem, registration fees, and other related costs. The proposed travel must be related to the project, and costs must be reasonable. Foreign travel requires prior approval.

> **NOTE:** Projects must allow costs for (1) attendance at up to four Project Advisory Committee meetings each year (assume this will be held at the Lead PI's institution), and (2) travel to the annual CIEE Conference or equivalent activity to present project results (date and location TBA). For the conference, we suggest you budget $200 for housing/registration fee, $200 for airfare, and $100 for miscellaneous costs.

G. Publications: All deliverable reports and/or technical papers may be distributed under CIEE's own cover or under the investigator's institutional cover as determined by CIEE. The PI with primary authorship responsibility is responsible for submitting 50 copies of the finalized

report(s) to CIEE for distribution to project sponsors. Each PI is responsible for maintaining an additional inventory of copies for response to requests for the report(s). CIEE also encourages PIs to publish the significant results of the project in the archival literature. The project budget should include adequate funds to cover these expenses.

H. Miscellaneous office expenses: Includes office supplies, postage, telephone, etc. Detail on Explanation page any individual item costing $1,000 or greater.

I. Other Direct Costs: Include such items as departmental recharges, utilities, and non-tangible procurements (e.g., costs for hosting a proposed workshop).

J. Total direct costs (C through I).

K. Indirect costs: Show rate and base; if some items have different rates or are excluded from the base, explain.

VI. AWARDS

CIEE intends to award a Subcontract to the research team whose proposal contains the combination of factors offering best overall value to CIEE. CIEE reserves the right not to make an award under this solicitation, and to solicit additional proposals. It is anticipated that a contractual agreement will be in place by the second calendar quarter of 1999. All institutions participating in the selected proposal will be subject to CIEE's terms and conditions; a copy of the terms and conditions will be forwarded to each participating institution following proposal selection

MARKET TRANSFORMATION RESEARCH:
MARKET CONNECTIONS FOR NEW COMMERCIAL BUILDING TECHNOLOGIES

SCOPE OF WORK

Background and Purpose

This project is anticipated to be a multi-year effort to develop market transformation theory and models for the new commercial buildings sector. These are needed to contribute to the formulation of market transformation strategies aimed at increasing the adoption of energy-efficiency practices and technologies. It is intended that (1) multiple disciplines of the sociological, economic and other relevant behavioral sciences be applied to a research effort to characterize and model the new commercial buildings market, and (2) this effort will have a focus on research questions that are thought to have a connection to possible market transformation initiatives. This would be followed by the use of the model(s) in designing pilot projects for market transformation.

This scope of work describes the first phase of the project that emphasizes multi-disciplinary development of market theory and models, with some preliminary work in market transformation—all with clear connection to possible market transformation initiatives for energy-efficiency practices and technologies. First phase work in market influences, market trends, preliminary transformation hypotheses, and preliminary transformation models is intended to ensure that the market model has sufficient predictive ability and is able to effectively describe important changes in market functioning.

The results of this first phase will be used to determine the scope of work in additional phases, which is anticipated to include validation of market models, development of robust market transformation models, development of market transformation strategies, and validation of transformation models through design and evaluation of pilot market transformation initiatives.

Task Descriptions

Task 1: Market Theory. Recipient will develop a theoretical base for new commercial building market analysis, focusing on the set of research questions described in Subtasks 1a through 1g below. Work will focus on three diverse subsector building types to be selected for investigation in the first phase (e.g., speculative office, owner-occupied health care, retail supermarket, etc.), leading to development of theory for other subsectors in future phases. Both speculative and owner-occupied markets will be among those selected for exploration in the first phase. Selection of markets will also be based on the strongest opportunities for developing the knowledge base for theory and model development, and on the size or growth rate of the market.

To accomplish this, Recipient will complete an appropriate review of the theoretical and empirical literature in the disciplines of economic sociology, organizational sociology and psychology, transaction cost economics, economics of industrial organization, technology-society studies, sociology of architecture/design, ecological modernization, and evolutionary economics. Recipient will also complete an appropriate review of applied literature to include energy policy analysis, energy efficiency program evaluation, energy social science, and marketing. Research of interest concerns the structure and dynamics of multi-organizational networks, design processes, organizational/industrial change, and technological innovation.

In addition, Recipient will conduct field studies of market processes using ethnographic observation, interviews of market actors, rapid appraisal, and participatory research techniques as appropriate. Focus will be on construction budget resource allocation and pre-design through commissioning, post-occupancy evaluation, and other stages of the building life cycle relevant to the new building market. Recipient will create and build theory upon a taxonomy of market sectors to include speculative vs. owner-occupied; design/bid vs. design/build; office, various retail subsectors, health care, etc. The aspects of market theory to be investigated include, but are not limited to, those described in the following subtasks:

> **Task 1a: Risks and Rewards for Innovators.** Recipient will characterize the existing commercial building market with respect to risks and reward mechanisms (or deficiency thereof) for innovators who implement energy-efficiency practices and technologies. This will include reward mechanisms associated with both energy-related and non-energy benefits of energy-efficiency technologies (e.g., improved building integrity, extended building life, improved worker performance through improved aesthetic and indoor environmental conditions, reduced first cost, reduced maintenance costs, reduced operating costs, reduced life-cycle costs, reduced environmental impact). Characterization of the reward mechanisms will be in the context of appropriate rewards to balance the risks inherent in innovation. The study of risk and rewards for non-energy-related innovations will also inform this work, pointing out potential important differences and dysfunctional aspects of risk/reward mechanisms for energy-related innovations.
>
> **Task 1b: How Information about Benefits is Made Available to the Market.** Recipient will investigate and describe current mechanisms by which information about benefits of energy-efficiency practices and technologies is made available to the market. This will focus on the resulting perception of potential rewards for innovation.
>
> **Task 1c: Market Feedback: Post-Occupancy Evaluations.** Recipient will characterize the nature and impact of post-occupancy evaluations (POEs) as a mechanism for providing feedback to "buyers" in the commercial buildings market. This will include assessing perspectives of all market actors that interact with POEs.
>
> **Task 1d: Market Feedback: Third Party and Other Mechanisms.** Recipient will investigate and describe the current role (or lack thereof) of third-party actors (e.g., Consumer Reports or J.D. Powers) in providing market

feedback. Recipient will identify other feedback mechanisms that provide or have the potential to provide a more effective market.

Task 1e: Compromise Processes and the Default Case. Recipient will characterize the compromise and negotiating processes between the various parties to the building process. This will include investigation of the "default case" hypothesis (that conventional building follows a pattern of least-resistance design compromises). A focus will be on the strength of representation of building user interests in the negotiation processes and the default case.

Task 1f: The Strength of Representation of User Interests, and POEs/Commissioning. Recipient will investigate mechanisms, including POEs and commissioning that affect representation of user interests. The relationship between these two potentially complementary practices will be examined. This will include assessing the perspectives of all market actors interacting with the compromise processes and the related mechanisms.

Task 1g: Legal and Regulatory Ground Rules. Recipient will identify and characterize laws and regulations that significantly influence the function of the commercial buildings market with regard to energy-efficiency practices and technologies. The intent and actual effect of these "rules" will be assessed. One important set of laws and regulations to be investigated is related to liability. The relative use of commissioning vs. POEs in different liability law jurisdictions is one area to be investigated.

Task 2: Market Model

Task 2a: Model Development. Recipient will use systems-delineation to synthesize information developed in Task 1 into a commercial building market model. The model will include the diverse subsector markets selected in Task 1, leading to extension of the model to other subsectors in future phases. The model will be sufficient to emulate the observed characteristics of the market including: reward mechanisms to balance risk for innovators, existing market feedback mechanisms, compromise processes and the strength of user interests, patterns of innovation and learning, other aspects identified as being important market mechanisms, and interactions between these facets that affect the use of energy-efficiency practice and technologies. The market systems and subsystems should also be described in sufficient detail to enable the mapping of networks of actors and arrangements that provide opportunities for intervention for market transformation.

Recipient will synthesize available information regarding commercial building activity in California, linking this information with the model to enable the assessment of impact of various market transformation interventions on the different market sectors (e.g., speculative, owner-occupied; design/bid, design/ build; office, various retail sectors, etc.). The model will also be robust enough to handle augmentations to effectively describe transformation or change in market functioning (see Task 3). Differences between sectors should be represented to the extent necessary to identify significant variations in potential effectiveness of intervention strategies. The model should be reviewed against the original sources of information used in its development to verify accuracy and continuity in the synthesis.

Task 2b: Validation Plan for Market Model. Recipient will develop a plan for validation of important aspects of the market model. The proposed method must use information and analysis independent of that used in development of the model.

Task 3: Preliminary Market Transformation Theory

Task 3a: Market Influences and Trends. Recipient will use key industry informant interviews and documentary methods to investigate and characterize industry/market trends and developments (e.g., green buildings, social and architectural movements, changing organization of work, performance contracting, etc.). This work should insure that the market model developed in Task 2 is capable of adequately describing market influences and trends. Recipient will evaluate the degree to which each incorporates, is complementary to, or is in conflict with innovative energy efficiency practices and technologies.

Task 3b: Preliminary Development of Market Transformation Hypotheses. Recipient will develop preliminary hypotheses regarding potential transformations of the commercial buildings market. Hypotheses will be developed in the context of the market model described in Task 2. The preliminary list of hypotheses to be considered includes but is not limited to the following:

- markets can be influenced to function more effectively as "habitats" that select for cost-beneficial energy-efficiency practice and product innovations,
- increased feedback to "buyers" regarding performance and satisfaction will improve the performance of the market,
- increased dissemination and/or improved credibility of information concerning the benefits of energy-efficiency practices or technologies will result in increased market share,
- alternative methods of organizing the construction process have varying levels of compatibility with innovation of energy-efficiency practices and technologies,
- apparently isolated successes by facilitators and brokers for energy-efficiency practices can be replicated for broader market impact,
- changes in legal (e.g., liability) and regulatory rules are effective in market transformation,

- alternative (e.g., performance) contracting methods can influence adoption of energy efficiency practices and technologies, and
- patterns of learning and innovation can be modified in ways that encourage adoption of energy-efficient practices and technologies.

Task 3c: Preliminary Market Transformation Model. Recipient will initiate preliminary development of a commercial building market transformation model, synthesizing preliminary market transformation hypotheses with the market modeling in Task 2. This preliminary work should ensure that the market model developed in Task 2 is sufficiently predictive and compatible with and adaptable to potential models for transformation. It should also ensure that the model is capable of recognizing and indicating improvements in market functioning

Task 3d: Pilot Study Venues. Recipient will identify potential pilot project venues for testing of market transformation strategies to be developed in future phases. This will include preliminary assessment of appropriate geographic scope associated with various potential strategies.

Task 4: Project Advisory Committee: A project advisory committee (PAC), consisting of representatives of CIEE partners and other interested institutions, has been identified by CIEE and the CEC. Recipient will organize and lead communications with the PAC, including organizing up to four meetings as appropriate, and coordinating changing PAC membership. The PAC is intended to provide input about ongoing industry activities related to the project, ideas about the scope of work of future phases, review of project deliverables, and advice when needed regarding project direction.

Task 5: Technology Transfer: Conference Presentation and Report Summaries. Recipient will send appropriate representative(s) to an annual CIEE Conference or equivalent activity to present findings to CIEE sponsors and interested researchers, will maintain a World Wide Web page describing the project as it progresses, and will provide CIEE with project summaries for publication in the conference program volume, CIEE Annual Report, and CIEE Web page.

Deliverables

In addition to the deliverables identified below, intermediate deliverables crucial to the progress of the project may also be proposed.

3 **Quarterly Status Reports**: No later than 10 business days after the end of a calendar quarter, researchers will submit a brief quarterly status report (format to be provided by CIEE).

4 **Project Summary Articles** for the CIEE Website, CIEE Annual Report, and CIEE Conference or equivalent (Task 5).

3. **Review Draft Report:** A complete review draft of the final report will be submitted to CIEE one month prior to project completion. This report will include documentation of all aspects of the project including presentation and documentation of market and market transformation models.
4. **Final Report:** Recipient will revise the draft final report in response to comments from CIEE staff and PAC members. Recipient will also be responsible for arranging for technical peer review of the draft report and incorporating reviewers' comments in the final report. The final report and 50 copies will be submitted to CIEE.

APPENDIX VI

FINAL REPORT OF 1999 CIEE TRIENNIAL REVIEW

CALIFORNIA INSTITUTE FOR ENERGY EFFICIENCY

(CIEE)

TRIENNIAL REVIEW

APRIL 12-13, 1999

REVIEW PANEL REPORT

MAY 10, 1999

REVIEW PANEL:

Don Colliver
Bruce Ellsworth
Arnold Fickett
Cheryl Gibson
Jeffrey Harris
Malcolm Lewis
Thomas Tyson

I. INTRODUCTION

The Triennial Review Panel met with the California institute for Energy Efficiency (CIEE) on April 12-13, 1999 for the purpose of conducting the third triennial review or CIEE. Previous reviews had been conducted in 1993 and 1996. The specific charge from the University or California's Vice Provost for Research, Robert Shelton, to the Panel was to evaluate:

- the strength and quality of CIEE's research and development program;
- CIEE's progress in accomplishing its mission and goals and multi-year research plans as approved by its Research Board;
- prospects that continued support will lead to further progress in meeting these goals;
- the effectiveness of CIEE's management; and
- the responsiveness of its program to the needs of California's ratepayers and its largest electric and gas utilities, the California Energy Commission (CEC) and the California Public Utilities Commission.

Vice Provost Shelton further requested that the Panel "look forward" and project how the CIEE might relate to a new, more complicated era that will necessitate both more enlightened research management and new educational opportunities.

As can be seen from Attachment A, the Panel represented a number of perspectives:

- national utility collaborative research
- university research and national technical association
- regional energy efficiency alliance and market transformation
- state regulatory commission
- residential building industry
- commercial building industry
- industrial research and development

This was the first time that the "users of research" (the building industry) had been involved in a CIEE review panel; their perspectives were particularly helpful in assessing the "value of the R&D to the consumer".

In advance of the on-site review, the CIEE Research Board members were invited to provide input directly to the Panel chairman. Ten Board members (all except Vice Provost Shelton who recused himself) provided information that was shared with the Panel prior to the review. This information and, its possible significance, is discussed in Section III of this report.

This report is organized into the following sections:

II. General Observations: provides a discussion of the Panel's views regarding CIEE's overall performance as well as its major strength and weaknesses.

III. Research Board Comments: discusses the input received from the individual members of the Research Board.

IV. Response to the Vice Provost's Charge: responds to the specific questions raised in the "charge to the Panel".

V. CIEE’s Strengths: elaborates on the strengths that should be emphasized as the foundation of any future CIEE role.

VI. CIEE's Weaknesses: discusses concerns or perceptions that need to be addressed for CIEE to prosper.

VII. Response to the Vice Provost’s Request to “Look Forward”: presents the Panel's

thoughts on positioning the CIEE to serve the future need for enlightened energy research-management and new educational opportunities.

VIII. Summary Recommendations: summarizes the more important Panel recommendations to the University or California (UC), the CIEE, and the CEC.

II. GENERAL OBSERVATIONS

The CIEE staff's efforts to provide a comprehensive package of materials to the Panel well in advance of the meeting coupled with the complete set of presentation materials provided at the meeting and the excellent preparation by the individual presenters were of enormous help to the Panel. The CIEE staff is commended for these efforts.

The Panel also wishes to acknowledge the role of the CEC for supporting the review process and participating in the review. The CEC staff's insights were extremely valuable in helping the Panel understand the uncertainties and complexities of energy research in the future.

The Panel concluded that the overall quality of the CIEE program was outstanding (scoring 3.35 on a scale of l=poor; 2==fair; 3=good; 4=excellent). The value of the program (to California stakeholders) was also rated outstanding (scoring 3.43). It is noteworthy that the "user" members of the panel saw the "value" as slightly higher than the members on average. It is also noteworthy that CIEE achieved this rating despite the uncertainties of the past several years. The Panel attributed much of CIEE's outstanding performance to the efforts of a very dedicated staff committed to the mission of improving energy utilization in California.

The CIEE stakeholders have invested substantially in CIEE for ten years. Over that time, CIEE has learned much and matured into an outstanding energy research management organization.

Specifically it has learned to:

- consider the potential benefits (if successful) from a total energy systems perspective before project initiation;
- consider the infrastructure required to successfully deploy products into the market place and bring that infrastructure together early in the research phase;
- be flexible in managing intellectual property (owning intellectual property is not always the most effective way to optimize benefits for California stakeholders) as well as in negotiating other contractual requirements;
- network with other California stakeholders to assure that all interests are brought to the table; and, conversely, that these other stakeholders are available to expedite market transformation.

The Panel asked each of the principal investigators who made presentations during the review whether the specific research would have been undertaken without CIEE involvement. In every case the answer was either a) the work would not have been undertaken at all or b) the work might have been sponsored by someone else, but the results (to the market place) would have been delayed by many years (i.e. ten years in the case of duct sealing).

Thus, the Panel concluded that CIEE might be unique in its role as well as in its maturity and its approach to energy research management.

Specific comments of Panel members include:

- "Remarkable that program has stayed alive in such a turbulent funding climate. A real credit to tenacity and commitment of CIEE management."
- "CIEE has done an excellent job of bringing the end-users / and industry partners into each of the projects - yielding a high probability of successful commercialization. This is really rare in the R&D world."
- "Excellent in getting solutions into market place (e.g. duct sealing, building codes)."
- "Bringing results of projects to the 'public' is very important - need to keep up that good work. CIEE shows dedication and commitment."

In answer to the question, "should CIEE have a continuing role in California's energy future?" The Panel responded with a score of 3.43 (l=absolutely no; 2=no; 3=yes; 4=absolutely yes). If CIEE's capabilities are lost to California, there is no doubt that there will be a significant cost (or lost opportunity) to California energy stakeholders.

III. RESEARCH BOARD COMMENTS

Attachment B provides a summary of the responses received from the ten members of the Research Board. On a scale of l=poor; 2=fair; 3=good; 4=excellent, the Research Board's average score for Overall Rating in 1999 was 3.4; this compares to 2.8 in 1996 and 2.6 in 1993. Furthermore, in all categories where there were comparable questions in 1996 and 1999, ratings were higher in 1999. (Questions were not comparable in 1993, so comparisons are only appropriate in the Overall Rating for that year.) Not only did ratings improve significantly from 1996 to 1999, but also the number of Board members who chose to participate in the survey increased from five in 1996 to ten (all eligible) in 1999. In addition, while several of the comments received from Board members in 1996 were negative or critical, the comments in 1999 are generally positive and supportive. This shift in Board member sentiment would seem to reflect a continuing improvement (learning) by CIEE and a willingness to respond to the recommendations and needs of others. The comments of the Research Board members (Appendix B) warrant review by readers of this report

IV. RESPONSE TO THE VICE PROVOST'S CHARGE

- The strength and quality of CIEE's research and development program was judged to be outstanding. Comments include:
  - "Knowledgeable staff" help direct the projects. Goals get "accomplished."
  - " Appears to be doing work that indeed would not be done by market. Industry uptake of work would seem to validate the quality of research."
  - "Focus on system approach is very important "
  - "Persuasive argument that, but for this (CIEE) R&D, this work wouldn't be done."
  - "Generally a high quality applied research program based on strong scientific foundation."
- CIEE's progress in accomplishing its mission and goals has been good / excellent particularly if one considers the hurdles (funding, shifting priorities, sponsors, etc.) it has faced. Its tenacity has in many cases been the only constant over the past few years. Typical comments include:

  "Good, but clearly hampered by funding uncertainties - excellent in getting R&D results into action."

  "Excellent progress in accomplishing a big part of mission goals and objectives in a very difficult environment"
- The prospects that continued support will lead to further progress in meeting these goals is extremely high if the support is provided in a manner that allows CIEE to exercise its strengths. Specific comments include:

  "Needs to be an active partner with CEC - not a subcontractor - UC educational assets should strengthen possibilities of providing a key leadership role in EEMT (Energy Efficiency Market Transformation) program."

  "With continued support (projects), more widespread use will be possible."

  "There remain significant needs in the building industry, a number of these projects will continue to address these needs."

  "Seems very clear that funding will lead to substantial progress, build upon the lessons learned."
- CIEE's management is very effective. The Panel was impressed by the dedication, flexibility, tenacity and knowledge. Comments include:

  "Very good, dedicated and effective."

  " A lot of the project results would not have been implemented without the direction of CIEE."

" Appears to be quite good - it's always difficult to walk the line between allowing researchers freedom to follow the work versus getting deliverables and results - CIEE seems to have found a good balance. "

"Good at managing projects, marginal at developing alternative new role for CIEE."

" Appears effective - good use of private sector."

- The responsiveness of the CIEE program to the needs of California's ratepayers, its electric and gas utilities, the California Energy Commission and the California Public Utilities Commission is outstanding. This is reflected in the ratings of the Research Board comprising representatives of the various stakeholders as well as the Panel. Typical Panel comments include:
- "Have been very responsive to the needs identified while at the same time doing an excellent job identifying problems and solutions unique to California."
- "Excellent job of getting solutions to the market place."
- "Definitely responding - duct losses and work to correct problem is very important. Research done to make homes energy efficient is great."
- "I'm impressed by the collaboration with industry, particularly the buildings industry representations. "
- "Should add agriculture projects; do more top-down planning of research topic priorities rather than only responding to proposals."
- "Very responsive although ratepayers may need to be convinced that these are problems that needed to be solved."

V. CIEE'S STRENGTHS

CIEE's strengths are numerous and result in its uniqueness as a research management organization. The more important strengths in the eyes of the Panel are discussed below. The Panel realizes that one or two of these strengths may be viewed by others (with a different perspective) as concerns. The areas where such discrepancies might occur are also discussed.

The Panel concluded that CIEE's more important strengths were:

- Ten years of research management experience resulting in a staff skilled in developing research projects that have "built-in" provisions for market deployment, if successful. Furthermore, their experience is leading them to begin to view research from a system's perspective rather than from the perspective of a single component or project.
- A tenacious and dedicated staff that is completely committed to the mission of improving energy utilization in California.
- A highly developed collaborative network of researchers, implementers, users, and other stakeholders that can assist in determining priorities and deploying products.
- A knowledgeable staff with ready access to a matrix of national laboratory, university and other highly competent researchers. (The Panel acknowledges that the link with Lawrence Berkeley Laboratories is viewed by some as an issue. Although the Panel views the relationship as positive, it does agree that the perception of a "too close" relationship needs to be addressed.)
- A Research Board that (particularly with the addition of the representative from the California Building Industry Association) reflects the interests of California stakeholders. The Board seems more interested in CIEE's future role than in the past and should be of assistance as CIEE repositions itself for the future.
- CIEE's understanding of the need to be flexible in dealing with "intellectual property" and contractual negotiations. Getting a product to the market place is extremely difficult and the incentives required vary depending on many variables (cost of setting up production facilities;

likelihood of competition, size / timing of the market, etc.). A standard contractual or intellectual property approach is unlikely to serve all situations. CIEE has shown excellent judgment in managing its negotiations to optimize the de1ivery of benefits to the consumer. (The Panel recognizes that research funding organizations have been slow to accept the need for such flexibility and may prefer to use "boiler plate" terms and conditions under all situations.)

- CIEE's willingness and ability to take risks. Over the years, CIEE has provided seed money to a number of researchers who could not secure funds from other sources. Several of those "seeded efforts" have resulted in successes that led to subsequent funding by the larger institutions. Two examples are a) the "duct sealing" effort where l50K of CIEE funds led to 850K of support from EPA, EPRI, etc., and b) the "fume hood" effort where 25K of CIEE support led to DOE / industrial contributions of 250K (counting 'in-kind' support). Thus, CIEE's ability to recognize value in high-risk projects allows them to leverage substantial funds from others and obtain benefits that would otherwise be lost. (The Panel understands that some may see this risk taking as a negative. Yet it is the Panel's opinion that a small percentage of research funds should be set aside for high risk, high payoff research particularly if the selection is made by a knowledgeable group with a good track record.)

VI. CIEE'S WEAKNESSES

The Panel did observe weaknesses (or perceived weaknesses) that may have limited CIEE's ability to accomplish more or better position itself for the future. The most obvious concerns are discussed below:

- CIEE does not have a well articulated (at least the Panel is not aware of one) role and rationale for the future. CIEE staff have conducted many discussions with various stakeholders in an attempt to position themselves in an uncertain future, but it is not clear that they have done a good job in defining CIEE's niche and its justification (CIEE's uniqueness, what it does best, how it can bring value far in excess of it's costs, etc.). For instance CIEE’s overhead costs have been substantially reduced since moving from LBL to UC and are now quite reasonable- certainly CIEE can show that its value exceeds such costs.
- The perception that CIEE exists as a conduit for Lawrence Berkeley Laboratory (LBL) research is a concern. (Inasmuch as LBL fostered the creation of CIEE, provided it a home, and was the beneficiary of a large fraction of CIEE's early research funds; it is not surprising that some perceive a closer CIEE-LBL relationship than currently exists, particularly given CIEE’s new home at UC.) Nevertheless, if CIEE is to be recognized as an "even-handed" California energy research management organization, it must work to shed this perception - without "bending over backwards" so far that it does not make use of LBL's unique talents when appropriate.
- CIEE's portfolio of projects is very narrow - essentially limited to residential buildings, commercial buildings, and air quality. While the Panel would like to see this portfolio expanded to other activities, it understands that this is probably not the time for expansion - having noted this weakness, the Panel's advice is "to stay the course" until CIEE has defined its future role.
- CIEE conducts little or no public relations on its own behalf. Although CIEE does an excellent job of communicating research results, promoting products, and crediting the researchers who do the work; it does little to publicize its own role. Yet, every project manager volunteered that CIEE's role was vital if not critical to the success of the project.

VII. RESPONSE TO THE REQUEST TO "LOOK FORWARD"

Looking forward into an uncertain and turbulent future is, at best, difficult. Nevertheless, given the benefits delivered by the CIEE to date, its maturity as an energy research management organization, and its other strengths as enumerated above, it is important to "look forward" and envision a future role through which CIEE can continue to serve California.

The Panel suggests that CIEE consider this an incremental process with CIEE's role gradually shifting as appropriate. Three years may be required to position CIEE in an optimum role - new relationships need to be established, perceptions changed, policies and procedures modified, etc. etc. Also, the question of California's energy research funding beyond 2001 is yet to be resolved. Thus, the Panel has outlined a multistep process that could be started immediately and continued pragmatically as the future unfolds.

- First, CIEE should develop a portfolio / prospectus of what it is, what it is not, what it does best, what it can offer, etc. The prospectus should have technical depth, include successes / approaches, and discuss research management techniques. There should be compelling arguments for the added value of CIEE (to at least compensate for the added cost of CIEE overhead). The prospectus needs to differentiate ClEE from other players in the California energy arena (what is special, unique). Carl Blumstein's Strategic Planning paper is a good start but needs to be converted from a "strategic" focus to a "capability" focus. The prospectus needs to be articulated in at least two written formats - one concise but multipaged for detailed presentation, a second in one-two page summary format for decision makers. The document needs to be fully endorsed by UC and it would be extremely useful if UC can provide input to expand the CIEE vision (see the last bullet below). This prospectus should be considered "living", subject to modification over the next three years as the future becomes more certain, the CIEE / UC / CEC relationships develop, and CIEE continues to strengthen.
- Second, CIEE should be grateful to the CEC for recognizing the importance of the ongoing CIEE projects and providing the necessary transition funds. In the nearer term, CIEE should continue to work with CEC in any role that would further research to improve energy utilization in California. However, for the longer term, CIEE / UC / CEC should do whatever necessary (and it may be very difficult) for ClEE to become an affiliate or adjunct (rather than a subcontractor) to CEC for the management of an appropriate portion of the Public Interest Energy Research (PIER) activities. This would, in effect, expand the CEC staff capabilities (particularly in the residential and commercial buildings arenas) without adding layers of administration / management; and it would immediately expand the CEC collaborative network / infrastructure. The contractual details among the organizations would need time to work out but hopefully they could be developed to allow the CEC the necessary oversight / controls to satisfy its mandate while providing the CEC affiliate (CIEE) some flexibility to manage intellectual property, etc. to optimize market deployment of research results / products.
- Third, CIEE should work through its Research Board and the private sector electric utilities to manage a portion of the Energy Efficiency Market Transformation (EEMT) funds as well as continue to manage targeted research funds from other organizations. CIEE should position itself to "tie" the CEC PIER efforts to the EEMT and other market place activities, i.e. "CIEE should be considered the California organization with the demonstrated collaborative networks and infrastructure to best provide the 'research to market' bridge. "
- Fourth, CIEE / UC should consider the future educational implications that might relate to the development and deployment of energy utilization technologies; and then develop an educational outreach program in conjunction with CIEE. This would, in effect, allow CIEE / UC to define an ultimate vision / role as the expert in providing research management expertise, educational opportunities and a source (through educational programs) of future experts in expediting the research, development, demonstration and utilization of energy efficient technologies.

VIII. RECOMMENDATIONS

The Panel's more important recommendations are summarized below.

- Develop a prospectus for CIEE (as discussed in Section VII).

- Take care to properly reflect CIEE's image. Make sure that communications do not confound CIEE with LBL. Make clear that CIEE does research management and contracts out the research to many other organizations. (While separating its role from LBL's, CIEE must use the most competent researchers even if they are LBL personnel.) Articulate the important role CIEE has played in "seeding", "leveraging", "deploying", etc.
- Continue to build on the strengths -- expand the collaboration of energy research organizations (horizontal network) as well as the collaborative infrastructure of energy research, development, deployment and utilization organizations (vertical network); and do what is necessary to maintain / augment the "CIEE team" during what will be a very difficult 1-3 years.
- Work with the CEC to develop a means for CIEE to become a CEC affiliate / adjunct to assist in managing the PIER efforts. This would avoid unnecessary levels of bureaucracy and allow each organization to exercise its strengths.
- Aggressively pursue EEMT funding as well as targeted funds from individual organizations. This will allow CIEE to best use the strengths of its collaborative infrastructure to couple research and market transformation.
- UC / CIEE should consider educational implications that will stem from the changing energy environment; and involve CIEE in educational outreach programs. This would "flesh" out a CIEE role that would nicely "tie" together the various California organizations and future needs. There is much to learn and teach in how to "transform energy markets".
- Continue to view research / technology from a "systems approach". While the Panel commended efforts in this direction, it also feels that more work is required before CIEE can claim to have a "total systems approach". For instance, the thermal distribution system project takes many interactions into account but not latent heat, air quality, etc. - good start but a ways to go.
- CIEE / CEC / UC need to consider ways in which exploratory research activities can be pursued in the future. The Panel felt that the Exploratory Research and Opportunity Research Programs were very important elements of the CIEE activity. At about ten percent of the total CIEE budget, these efforts have provided the "seed" money for several good projects that would never have been funded otherwise. It seems that high risk / high payoff exploratory research is becoming a victim of the national focus on application and market transformation. It would be good if a few dollars could be set aside for the "seed corn" of future energy products.

Attachment B

SUMMARY OF
CIEE RESEARCH BOARD RESULTS

Overall Rating of CIEE and its R&D Program (scale: poor, fair, good, excellent)

Six: good
Four: excellent

Responsiveness of CIEE's R&D program to end-use energy efficiency needs of California's electricity and natural gas consumers.

One: fair
Three: good
Six: excellent

Quality of research conducted by Principal Investigators funded by CIEE

Three: good
Seven: excellent

Likelihood that California electric and natural gas consumers will derive significant energy efficiency, environmental and economic benefits

Two: fair
Four: good
One: good / excellent
Three: excellent

Responsiveness of CIEE to policy guidance and direction from the Board

Five: good
Five: excellent

Willingness of CIEE in considering promising project ideas submitted by Board, Planning Committee, etc. as basis for new projects or project modifications

Two: fair
Three: good
Four: excellent
One: abstention

Quality of CIEE project management

Six: good
Four: excellent

Effectiveness of CIEE and its Principal Investigators in communicating project results to its sponsors, stakeholders, etc.

One: fair / good
Seven: good
Two excellent

Other Comments:

A) Documentation of benefits of completed R&D would be extremely beneficial to ClEE.

B) Focus, focus; drive the program based on strategy rather than LBL activities.

C) ClEE serves the "public interest" RD&D agenda well. CIEE has also shown an interest in bringing promising technologies to the market - this is new. I question how effective CIEE can be in commercializing emerging technologies because it lacks experience. Either CIEE needs to build commercialization "know how" into its management team or hand-off to others when applicable. All CIEE multi-year projects should undergo critical review at least once a year and compared to other investment opportunities.

D) The degree of market penetration of projects developed and the period of time CIEE products have been available to the market is not well understood (communicated).

E) CIEE has produced high quality R&D in a consistent manner during the years that CBIA has been involved with the group. It is this level of dependability that would make CIEE's program such a fine supplement to the Energy Commission's Building Standard's program; something we strongly support.

F) Continue to work with clients such as SMUD to tailor research in a manner that brings direct benefit to the community of Sacramento.

G) The strong point of CIEE is the half -dozen success stories in its portfolio, with short payback times.

a) Modera's work on duct losses. This will allow res. a/c to be downsized by about l kW, reducing first cost and energy bills.

b) Feustel's work on fume hoods (same comment as above).

c) CIEE took up Cool Communities about 5 years before DOE. Now EPA is about to announce that cool roofs, shade trees, is the top measure for State Implementation Plans.

H) From the Energy Commission's perspective, two major successes should be highlighted. The first is the responsiveness of ClEE to new program initiatives suggested by the planning committee. ClEE has initiated a new initiative in market transformation to better understand how to effectively get efficiency products into the market place. This research should be very useful to both efficiency programs and RD&D programs, and help California reach its policy goal of increasing the cost-effective energy choices available to customers.

The other area in which CIEE was very effective was in assisting the Commission in the building energy efficiency code development process. CIEE deserves credit for much of California's progress in the area of residential duct improvements. Several years ago CIEE's PI, Mark Modera, was instrumental in defining the problem. As a result of ClEE's research, the Energy Commission realized that the building code assumptions on duct leakage needed to be updated.

To take the research the next step, Jim Cole took the initiative to propose a collaborative of CIEE, CEC, CBIA, NRDC and utilities. The collaborative was very effective. It connected the researchers with the practitioners, and each stakeholder brought unique perspectives to the issue. This collaborative was probably the single most important factor in translating good research into a changed building practice.

A similar example is the envelope collaborative. Max Sherman has been key in developing a protocol on envelope leakage. It is very helpful when developing codes to have technical expertise of Mr. Sherman and Mr. Modera's caliber able to take technical research and

simplify into a workable code context. The CIEE researchers have been perceived as objective, independent experts.

A challenge for CIEE continues to be defining its mission in an ever-changing landscape. CIEE's director and project management staff have proven to be very pliable and adaptable. CIEE can play many roles in relationship to the public research program administered by the Energy Commission (the PIER program). CIEE can help define PIER program objectives, evaluate specific project feasibility, or manage a portfolio of projects. The Energy Commission and CIEE need to continue to discuss and clarify the desired role for CIEE in order to maximize CIEE's expertise.

APPENDIX VII

POTENTIAL SCOPE OF TECHNICAL ASSISTANCE AGREEMENT WITH CEC

Exhibit A
WORK STATEMENT

INTRODUCTION

The Research and Development Office of the California Energy Commission has selected the University of California (UC) as a technical support contractor for fiscal years 1999-00, 2000-01 and 2001-02. UC, as a condition of the contract, shall provide technical expertise to the Commission. UC will be directed by the Commission Contract Manager through work authorizations. An estimated total of up to $_____ is expected to be available for fiscal year 1999-00, $_____ for fiscal year 2000-01 and $_____ for fiscal year 2001-02 for a total contract value of $_____.

GENERAL REQUIREMENTS

UC and subcontractors will be directed by the Commission Contract Manager and Commission Projects Managers. UC will manage a team capable of undertaking all work assignments identified in this Work Statement. In all cases, UC must establish all necessary contractual relationships with all subcontractors and reimburse all subcontractors for services performed. The technical performance of subcontractors will be monitored by UC to the extent required by the Commission's Contract Manager on a case-by-case basis.

UC and its subcontractors will begin task work only after receiving a written Work Authorization to do so by the Commission Contract Manager. The specific tasks and the degree of effort for each task to be performed by UC and its subcontractors will vary from project to project. All project work performed by the UC team shall be directed by and coordinated with Commission staff as designated by the Commission Contract Manager. The actual costs of a completed, approved Work Authorization shall not exceed the authorized amount. If, in the performance of the work, UC determines that the actual costs will exceed the estimated costs, UC shall immediately notify the Commission project manager.

Any expenses incurred by UC that have not been duly authorized shall be borne by UC. No amendments to the Work Authorization shall be made for work undertaken without the specific approval of the Commission's Project Manager and Contract Manager.

GENERAL TASKS

Funding distribution for the tasks in this Contract will vary depending on the demand for work in each specific area with the exception of exception of Task 1, which will remain constant at 12 percent. The following is an example of a possible allotment of Contract dollars.

1.	Management Services	12 percent
2.	Program Technical Support	70 percent
3.	Project Technical Support	13 percent
4.	Technology Transfer	5 percent
		100 percent

Work Guarantee

Workflow will depend on demand for service and will be matched to UC's experience and expertise. Demand is uncertain and, therefore, there will be no guarantee of work for UC or any of its subcontractors.

Work Authorizations

This is a "work authorization" Contract and no work shall be undertaken unless authorized by the Commission through a specific written document called a work authorization.

The Commission Contract Manager will prepare and issue written work authorizations and may set a maximum price, budget, and schedule for the work to be performed.

TASK 1 MANAGEMENT SERVICES:

1.1 Work Authorizations. UC shall respond in a timely manner to requests and direction from the Commission Contract Manager to communicate with and, as appropriate, meet with designated Commission representatives to develop specific technical assistance assignments. Following discussions with Commission representatives, UC shall prepare a Draft Work Authorization that describes the objectives, scope of work, schedule and desired deliverables, identifies the UC staff, lead principal investigator(s) and other support staff that will conduct the technical assistance effort, and summarizes the budget for each work assignment. UC shall discuss this Draft Work Authorization with Commission representatives and make appropriate changes. The final Work Authorization shall be approved by the Commission Contract Manager.

1.2 Manage technical assistance work assignments. UC shall manage the efforts of the project team selected to perform each Work Authorization and shall establish all necessary contractual relationships that may be required with project team members. UC shall review and approve all invoices and provide appropriate technical, financial accounting and auditing oversight as described in this contract.

1.3 Management reports. UC shall provide periodic management reports to the Commission Contract Manager and other Commission contacts appropriate for each Work Authorization. Each report shall describe: work performed during previous reporting period, including a summary description of major Draft and Final deliverables completed; work planned during the next reporting period, including an estimated schedule for providing major Draft and Final deliverables during this period; planned versus actual expenditures; and any problems that may

impact the ability of the project team to accomplish the Work Authorization within budget or schedule. UC shall also provide a separate management report (using a similar reporting format) to the Commission Contract Manager that describes the status of these Task 1 Management activities as well as the overall status of all active Technical Assistance Work Authorizations.

1.4 Oversight and review of reports. UC shall provide oversight and technical review of all Draft and Final reports and other major deliverables, and comment on the content of these major project team deliverables, as requested by the Commission lead contact for each Work Authorization and the Commission Contract Manager.

1.5 Year-end report. UC shall prepare a brief 5-10 page, year-end contract report summarizing the major accomplishments of this Technical Assistance effort.

1.6 Contracting. Negotiate and execute agreements using established University of California policies and procedures.

TASK 2 PROGRAM TECHNICAL SUPPORT

Consistent with approved Work Authorizations, UC shall provide the following Task 2 services as requested by the Commission's Contract Manager.

2.1 Program implementation. Assist Commission staff in the planning, design, development, implementation, administration, evaluation and coordination of selected programs supported in whole or in part with Commission funds. Assist in identifying potential co-funders and in facilitating their participation.

2.2 Comparative evaluation of all energy technologies. Assist Commission staff in the evaluation of energy technologies relative to: their commercial status; the status of specific research activities and established research and development goals; the technical, financial, economic, regulatory, and environmental barriers to deployment; the appropriate policies or actions to meet research needs and mitigate deployment barriers, and their social cost or benefit. This activity includes the technical, economic, environmental and market analyses of each technology.

2.3 Targets and benefits of research, development and demonstration (RD&D). Assist in identifying those targets for RD&D support which would bring the greatest benefit to California, and in the evaluation of the benefits associated with RD&D programs and projects to improve California's energy supply and use mix.

2.4 Proposal evaluation assistance. Assist in the technical and economic evaluation of proposals received by the Commission for various state assistance and/or funding programs.

2.5 Market and resource analysis. Conduct market analyses and assist in evaluating market trends; growth patterns; resource availability; regulatory, economic, taxation and financial constraints; and decision factors for a technology or technology application. Assist in the evaluation of legislative and policy proposals for their effect on market development.

2.6 Program and project tracking. Assist staff in establishing and maintaining databases to track selected programs and projects funded by the Commission and other organizations.

2.7 Technical expertise for Commission proceedings. Assist Commission staff by providing technical experts for hearings, workshops and other meetings relating to technology and energy development issues, and in preparing technical information related to these issues for possible inclusion in Commission reports.

2.8 Respond to inquiries. Prepare analyses, findings, and recommendations in response to inquiries from Commission staff or from inquiries received by the Commission from public and private organizations. Prepare support materials as needed for each inquiry.

2.9 Environmental impacts. Assist in the evaluation of the global, regional, and project-specific environmental impacts, both cumulative and incremental, of California's energy supply and use mix, and of alternative mix scenarios, policies and programs.

2.10 Coordination of technical advisors and advisory committees. Conduct workshops and other outreach activities that seek comments from relevant individuals, industries and organizations for purposes of planning, designing, developing, implementing, administering, evaluating and coordinating selected programs.

2.11 Administration of cooperative programs. Act as the administrator under the direction of the Commission Contract Manager for cooperative programs sponsored jointly by the Commission and one or more public or private entities. Administer funds (other than Commission funds) held in trust for the program(s).

TASK 3 PROJECT TECHNICAL SUPPORT.

Consistent with approved Work Authorizations, UC shall provide the following Task 1.3 technical assistance as requested by the Commission Contract Manager.

3.1 Project implementation. Assist Commission staff in the planning, design, development, implementation, administration, evaluation and coordination of selected projects supported in whole or in part with Commission funds. Assist in identifying potential co-funders and in facilitating their participation.

3.2 Project evaluation assistance. Assist Commission staff in the evaluation of proposed or planned projects. Where required, prepare a project report that summarizes technology status, commercial viability, need for government and private sector involvement, environmental effects, engineering risks and market barriers, evaluation of work statement, schedule, budget and other issues as determined by Commission Contract Manager.

3.3 Project management. Assist Commission staff in managing selected projects. Project management tasks may include regular communications with project staff, evaluation of proposed changes in project work plans, review of progress reports, technical advice to contractors, and review of technical reports.

3.4 Scoping studies. In some cases, before a new project is initiated, a scoping study may be needed. A scoping study is a summary report that provides sufficient information to make informed decisions about further pursuit of a proposed project. The informational content will be determined in the Work Authorization and may include, but is not necessarily limited to, literature survey of related work; energy resource assessment, energy resource and energy demand compatibility assessment; technology and market assessment; economic and financial analysis; institutional considerations; and time schedules.

3.5 Administration of cooperative projects. Act as the administrator under the direction of the Commission Contract Manager for cooperative projects sponsored jointly by the Commission and one or more public or private entities. Administer funds (other than Commission funds) held in trust for the project(s).

3.6 Coordination of technical advisors and advisory committees. Conduct workshops and other outreach activities that seek comments from relevant individuals, industries and organizations for purposes of planning, designing, developing, implementing, administering, evaluating and coordinating selected projects.

TASK 4 TECHNOLOGY TRANSFER.

UC shall provide the following Task 4 services as requested by the Commission Contract Manager.

4.1 Facilitate dissemination of results. Provide facilitation and support services to develop, market and disseminate information giving the results of selected programs and projects. Coordination and support tasks include writing descriptive and technical material, producing graphics and Internet website materials, and coordinating development with staff, designers and printers.

4.2 Prepare informational and graphic materials. Assist staff in the design of presentation materials needed for workshops, press conferences, reports, case studies, and general distribution. Provide editing, graphics, photographic services and printing supervision.

4.3 Prepare informational written materials. Assist staff in technical writing needed for a wide range of presentation materials including reports, brochures, fact sheets, and newsletter articles.

4.4 Organize conferences. Arrange and provide logistics and supplies for conferences, workshops, review sessions, and other activities to improve information transfer between industry groups, utilities, small businesses, local governments, and the Commission.

4.5 Project identification. Assist staff in identification of programs and projects which require technology transfer assistance during the course of their development

APPENDIX VIII

INITIAL LIST OF CIEE TECHNICAL ASSISTANCE ACTIVITIES IN SUPPORT OF PIER BUILDING ENERGY EFFICIENCY PROGRAM

Date: May 25, 1999

To: Nancy Jenkins, PIER Buildings Program Manager

From: James Cole, CIEE Director

Subject: Summary of Discussion at May 12 Meeting

At the May 12 meeting, I discussed a hard-copy version of a viewgraph presentation with you for purposes of developing an understanding of the potential work scope of "technical assistance" effort (an electronic copy of this PowerPoint presentation can be forwarded to you upon request). Based on this discussion, the following is my current understanding of the list of tasks that might form the basis of this technical assistance effort.

Summary Description of Major Tasks

1. Review of proposals by Karl Brown in mid August timeframe.
2. Evaluate whether there are major R&D issues, needs and opportunities that are not addressed by CEC's Buildings R&D program; this will be done upon request in close consultation with Nancy Jenkins. It is currently anticipated that an initial evaluation of RD&D needs will be conducted in the fourth calendar quarter of 1999 after the CEC makes decisions regarding the funding of proposals submitted in response to the Building Energy Efficiency "programmatic solicitation"; this is currently expected to occur during the third quarter of 1999.
3. Prepare the statement of work (Exhibit A) and summary description of major project milestones and deliverables (Exhibit B) based on information in proposal; coordinate with potential contractor in finalizing the budget breakdown by major cost category (Exhibit C) (including the critical personnel effort level); this will be done in close consultation with the CEC project manager.
4. Assist CEC project manager in review and approval of invoices.
5. Help to ensure consistent quality of deliverables.
6. Communicate regularly with prime contractors
    - identify problems and opportunities
    - facilitate linkages among major programs
    - inform CEC Buildings Team of major issues
7. Meet monthly with CEC Buildings Team
    - review status of major programs and projects
    - coordinate technical presentation of a "timely" project by lead PI
8. Establish Project Advisory Committees and coordinate periodic meetings to review progress of major program elements, including but not limited to the activities identified in items 9, 10 and 11.
9. Help CEC and prime contractors develop "linkages to market" for major "awarded" programmatic contracts, including:
    - market transformation programs in California

- industry initiatives and other market transformation efforts A "baseline approach" for pursuing this market connection objectives is summarized in the following list of tasks that will be coordinated by CIEE:

  (a) PI(s) describe and periodically update status of major R&D Products, target audiences and market readiness during each phase of the project

  (b) CIEE helps prime contractor to identify and develop potential market pathways

  (c) CIEE coordinates independent review of this R&D product status information by PACs and other industry leaders

  (d) CIEE discusses results of independent review with CEC Buildings Team and PI(s)

  (e) CEC Buildings Team decides whether to modify project plan based on market feedback

  (f) CIEE and CEC discusses planning and funding of coordinated energy efficiency market transformation (EEMT) projects with utilities and other stakeholders

9. CIEE will coordinate with prime contractor in the preparation of a Draft proposal for the next phase of a multiyear project; this will be based on original plan for multiyear project, assessment of R&D progress by the CEC project manager, CIEE and the Program Advisory Committee and other feedback from market participants. This proposal will be discussed with the CEC project manager, Program Advisory Committee and the CEC Buildings Team as determined by the CEC project manager. CIEE will coordinate with the prime contractor in submitting a final proposal to the CEC that is responsive to requirements established by the CEC project manager.

11. Coordinate R&D efforts with DOE, EPA, EPRI, GRI, ASERTTI and other SEOs in close coordination with the CEC project manager and the CEC Buildings Team.