MAUI TOMORROW EXHIBITS
A97-722

Mr. Mark Sheehan
3681 Baldwin Avenue
Makawao, Hawaii 96768

RECEIVED
APR 2 4 1998
State of Hawaii
LAND USE COMMISSION

March 31, 1998

Dear Mark,

I was one of the participants in the IRP process who quit as a result of frustration with Maui Electric. The process was very tedious and drawn out with the end results being what Maui Electric wanted them to be.

It was an exercise in futility since generating power with oil is the only acceptable form considered by Hawaiian Electric, the parent company who actually makes policy. Maui Electric builds oil-fired power plants and is not interested in decentralized solar electricity, wind, biomass or other renewable resources.

Their interest is in making money, and they do that best by spending hundreds of millions of dollars building oil-fired power plants and passing the expense on to the rate payers. By utilizing decentralized photovoltaic systems, wind and biomass, we can eliminate the need for the proposed power plant. But none of these options are as profitable for Maui Electric as oil.

The IRP is a sham because it was never taken seriously for its true potential. It was co-opted by Maui Electric and used to justify their own self interests. Their interest is in maximizing profits, not in utilizing renewable resources. The PUC should require the use of renewable resources and a fundamental restructuring of the way Maui Electric, who has a monopoly on a vital service, conducts business. If the rate payer is paying the expenses, then they should have the right to do it utilizing appropriate technologies that clean up and not degrade our environment.

Maui Electric does not care about the environment, which is evident with their plans to build this huge oil-fire plant with no emissions controls. They pay lip service to the environment but only care about profits. The IRP was a waste of time, as most attempts to change things at Maui Electric seem to be. They simply don't care. Other participants in the IRP came to the same conclusion.

Sincerely

Herb Squires

Int's Exhibit No. 22
A97-722 Maui Electric Co, Ltd.

NAME/ORGANIZATION/POSITION	TO BE QUALIFIED AS AN EXPERT IN	SUBJECT MATTER	WRITTEN TESTIMONY	EXHIBIT NUMBERS(S)	LENGTH OF DIRECT
Madelyn D'Enbeau, Makawao Main Street Association, Chair	Community Land Use Planning and Values	Community values & impacts, relation between various plans for water and land use	Yes		1 hr
Prof. Dick Mayer, Maui Community College, Prof. of Economics	Community Energy Planning and Air Pollution	Energy Alternatives, Air Pollution	Yes		20 min
Ian Chan-Hodges, Pacific Monitor, Editor	Community Economics	Impact of industrialization on community values and resources	Yes		20 min
James Williamson, engineering consultant	electric power and water	fuel, air quality, and water	yes	3	30 min
Mark Drehsen, meteorologist	air quality	air quality impacts	yes	2	30 min
Roy Smith, Hawai'I Organic Farmer's Association, Board of Directors	air quality/health	air impacts and energy alternatives	yes	3	30 min
Erik Frye, Maui Tropical Farmer's Asociation, Vice-president	air impacts	air impacts on farming and related issues	yes	1	20 min
Steve Moser MD, physician	air quality and health	air quality health impacts And related issues	yes		20 min
James Watson, combustion engineer President of research & development North American Manufacturing Co.	combustion energy	fuel type and delivery, emissions, pollution control	yes	2	30 min

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Board of Directors
Mark Sheehan, President
Anthony Ranken, Vice-President
Celeste King, Treasurer
Susan Bradford
Lisa Hamilton
Edwin Lindsey
Louise Rockett

MAUI TOMORROW

Administrative / Program Director
Scott P. Crawford

P'O Box 429, Makawao, Hawai'i 96768 • 808-877-AINA • Fax: 808-248-7761 • aina@maui-tomorrow.org • http://www.maui-tomorrow.org

Exhibits

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1. Maui County General Plan

2. East Maui Water Development Plan and supporting documents

3. Highway Manuals refering to traffic counts and level of service

4. "Regional Energy Initiatives" - Na Makani Energy Initiative Project Report, Phase I

5. "Customer-Sited Photovoltaics - Focusing on Markets that Really Shine: A Study Highlighting The Best Markets In The United States For Grid-Connected Photovoltaic Systems," National Renewable Energy Laboratory

6. "Negawatts: Twelve Transitions, Eight Improvements, and One Distraction" by Rocky Mountain Institute in Energy Policy, 1996

7. "Renewables in Integrated Energy Systems," Rocky Mountain Institute

8. Written testimony from Richard Heede, Research Scholar, Rocky Mountain Institute

9. Written testimony from Michael Potts, Solar Utilities Network

10. "DSM Opportunity Report" Neof Corp. for State of Hawaii PUC, 1993

11. Honolulu Advertiser article, Jan. 11, 1998

12. Pacific Monitor articles, 11-12-95, 12-4-95, 12-11-95, 12-18-95, 5-27-96, 7-22-96

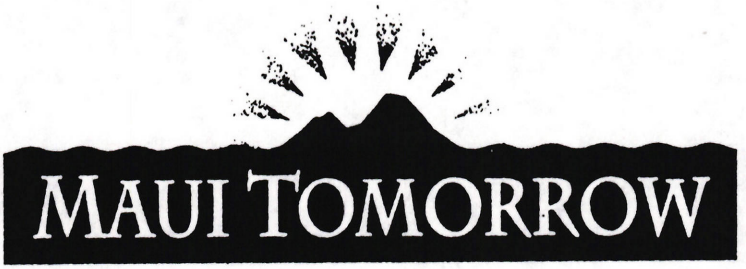
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ORIGINAL



P.O. Box 429, Makawao, HI 96768

LAND USE COMMISSION
STATE OF HAWAII
1998 FEB 11 A 9:58

BEFORE THE LAND USE COMMISION

OF THE STATE OF HAWAI'I

In the Matter of the Petition of MAUI ELECTRIC COMPANY, LIMITED To Amend the Land Use District Boundary of Certain Lands Situated at Wailuku and Makawao Districts, Island of Maui, State of Hawai'i, Consisting of 65.7 Acres from the Agriculture to the Urban District	DOCKET NO. A97-722 **MAUI TOMORROW'S SUPPORTING DOCUMENTATION, INCLUDING WITNESS AND EXHIBIT LISTS**

ORIGINAL

EXHIBIT NO.	DESCRIPTION	PARTY:OBJECTIONS	ADMIT
1.	MAUI COUNTY GENERAL PLAN, SECTION 4D, PGS 12, 13		
2.	REGIONAL ENERGY INITIATIVES-NA MAKANI ENERGY INITIATIVE PROJECT REPORT, PHASE 1		
3.	CUSTOMER-SITED PHOTOVOLTAICS-FOCUSING ON MARKETS- FOCUSING ON MARKETS THAT REALLY SHINE: a STUDY HIGHLIGHTING THE BEST MARKETS IN THE UNITED STATES FOR GRID-CONNECTED PHOTOVOLTAIC SYSTEMS, NATIOANL RENEWABLE ENERGY LABORATORY		
4.	"NEGAWATTS: TWELVE TRANSITIONS, EIGHT IMPROVEMENTS, AND ONE DISTRACTION" BY ROCKY MOUNTAIN INSTITUTE IN ENERGY POLICY,1996		
5.	"RENEWABLES IN INTEGRATED ENERGY SYSTEMS" ROCKY MOUNTAIN INSTITUTE		
6.	PACIFIC MONITOR ARTICLES,		
6A.	11-12-95 "FIRST IN A SERIES-WHO WILL POWER ..."		
6B.	12-4-95 "SECOND IN A SERIES"		
6C.	12-11-95 "THIRD IN A SERIES"		
6D.	12-18-95 "FOURTH IN A SERIES"		
6E.	5-27-96 "WHY IS MAUI SO EXPENSIVE TO POWER?"		
6F.	7-22-96 "DOES MECO PROTEST JUST A BIT TOO MUCH?"		
7.	AGRICULTURAL MAP OF MAUI COUNTY		
8.	HONOLULU ADVERTISER ARTICLE		
9.	HAWAI'I ORGANIC FARMER'S ASSOCIATION LETTER		
10.	HOFA LETTER FROM ROY SMITH		
11.	BYLAWS OF MAUI TOMORROW		

LAND USE COMMISSION
STATE OF HAWAII
1998 FEB 17 P 2:39

EΞHIBIT NO.	DESCRIPTION	PARTY:OBJECTIONS	ADMIT
12.	EFFECTED COMMUNITY MEMBERS ON THE MAUI TOMORROW ROSTER		
13.	RESUME FOR DICK MAYER		
14.	RESUME FOR IAN CHAN-HODGES		
15.	RESUME FOR JIM WILLIAMSON		
16.	RESUME FOR MARC DREHSEN		
17.	RESUME FOR ROY SMITH		
18.	RESUME FOR ERIK FRYE		
19.	RESUME FOR STEVE MOSER,MD		
20.	MINUTES OF DEC.15 1997 MAUI TOMORROW BOARD MEETING		
21.	MAUI TOMORROW ARTICLES OF INCORPORATION		

WITNESS LIST IN THE MATTER OF CASE DOCKET NO. A97-722

NAME/ORGANIZATION/ POSITION	TO BE QUALIFIED EXPERT IN	SUBJECT MATTER	WRITTEN TESTIMONY	EXHIBIT NUMBER	LENGTH OF DIRECT
Prof. Dick Mayer, Maui Community College, Prof. Of economics	Economics of energy planning &air pollution	community economic impacts, relation of various plans for water & land use	Yes	1,2,3,4	45 min.
Ian Chan-Hodges, Pacific Monitor Editor	Community Economics &Planning	Impacts on community economics & resources. Energy planning	Yes	1,2,4,6	1 hr.
James Williamson, engineering consultant	electric power and water resources	fuel & alternatives, air quality, & water	yes		1 hr.
Marc Drehsen, meteorologist	air quality	air quality and impacts	yes		45 min.
Roy Smith, Hawai'i Organic Farmer's Assoc. Board Member	Air quality, agriculture resource planning	air impacts on agriculture and health, energy alternatives	yes	3,4,7,8 9	45 min.
Erik Frye, Maui Tropical Farmer's Assoc. V.P.	Agriculture & air	air impacts on farming & related issues	yes	3,4,9	30 min.
Steve Moser MD, physician	air quality & health	air quality health impacts & related issues	yes		45 min.

BEFORE THE LAND USE COMMISION

OF THE STATE OF HAWAI'I

ORIGINAL

LAND USE COMMISSION
STATE OF HAWAII
1998 FEB 17 P 2:35

In the Matter of the Petition of MAUI ELECTRIC COMPANY, LIMITED To Amend the Land Use District Boundary of Certain Lands Situated at Wailuku and Makawao Districts, Island of Maui, State of Hawai'i, Consisting of 65.7 Acres from the Agriculture to the Urban District	DOCKET NO. A97-722 AMENDMENT TO CERTIFICATE OF SERVICE

AMENDMENT TO CERTIFICATE OF SERVICE

I hereby certify that a copy of Maui Tomorrow's supporting documentation including witness and exhibit lists was served upon the following by U.S. Postal service certified or priority mail:

David W. Blane, Director of Planning
Planning Department, County of Maui
250 South High Street
Wailuku, HI 96793

Dated Makawao, Hawai'I, this 13th day of February 1998 Mark Sheehan

Mark Sheehan
President of Maui Tomorrow

ORIGINAL

BEFORE THE LAND USE COMMISION

OF THE STATE OF HAWAI'I

LAND USE COMMISSION
STATE OF HAWAII
1998 FEB 17 P 2:35

In the Matter of the Petition of MAUI ELECTRIC COMPANY, LIMITED To Amend the Land Use District Boundary of Certain Lands Situated at Wailuku and Makawao Districts, Island of Maui, State of Hawai'i, Consisting of 65.7 Acres from the Agriculture to the Urban District	DOCKET NO. A97-722 CERTIFICATE OF SERVICE OF AMENDMENT TO MAUI TOMORROW'S LIST OF WITNESSES AND EXHIBITS

CERTIFICATE OF SERVICE

I hereby certify that a copy of Maui Tomorrow's supporting documentation including witness and exhibit lists was served upon the following by U.S. Postal service certified or priority mail:

Richard Egged, Director
Office of Planning
P.O.Box 2359
Honolulu, HI 96804

David W. Blane, Director of Planning
Planning Department, County of Maui
250 South High Street
Wailuku, HI 96793

Jeffrey Schmidt, Esq.
Corporation Counsel, County of Maui
Office of the Corporation Councel
200 South High Street
Wailuku, HI 96793

B. Martin Luna, Esq. Representing the Petitioner
Carlsmith Ball Wichman Case & Ichiki
One Main Plaza, Suite 400
2200 Main Street
Wailuku, HI 96793

Dated Makawao, Hawai'I, this 13th day of February 1998

Mark Sheehan

Mark Sheehan
President of Maui Tomorrow

BEFORE THE LAND USE COMMISION

ORIGINAL

OF THE STATE OF HAWAI'I

In the Matter of the Petition of	]	DOCKET NO. A97-722
	]	
MAUI ELECTRIC COMPANY, LIMITED	]	
	]	
To Amend the Land Use District Boundary of Certain Lands Situated at Wailuku and Makawao Districts, Island of Maui, State of Hawai'i, Consisting of 65.7 Acres from the Agriculture to the Urban District	]	CERTIFICATE OF SERVICE

LAND USE COMMISSION
STATE OF HAWAII
1998 FEB 17 P 2:36

CERTIFICATE OF SERVICE

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Richard Egged, Director
Office of Planning
P.O.Box 2359
Honolulu, HI 96804

Jeffrey Schmidt, Esq.
Corporation Counsel, County of Maui
Office of the Corporation Councel
200 South High Street
Wailuku, HI 96793

B. Martin Luna, Esq. Representing the Petitioner
Carlsmith Ball Wichman Case & Ichiki
One Main Plaza, Suite 400
2200 Main Street
Wailuku, HI 96793

Dated Makawao, Hawai'I, this 10th day of February 1998 Mark Sheehan

Mark Sheehan
President of Maui Tomorrow

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To SCOTT | From KAC
Co./Dept. | Co.
Phone # | Phone #
Fax # 572-1579 | Fax #

D. **ENERGY**

OBJECTIVE:

1. To make Maui County more self-sufficient in its need for non-renewable energy and more efficient in its use of energy.

POLICIES:

a. Encourage programs to test the feasibility of alternative sources of energy production.
b. Maintain an ongoing assessment of the County's energy resources, as well as an assessment of alternative sources in the context of a comprehensive integrated resource plan.
c. Publicize the need to conserve energy.
d. Create incentive programs to encourage the use of solar heaters and other energy saving building design concepts and devices.
e. Seek to incorporate energy-saving building design concepts and devices in government buildings.
f. Encourage the incorporation of energy-saving building design concepts and devices in all new private and public developments by providing energy efficient urban design guidelines and amendments to the Maui County Uniform Building Code.

E. PUBLIC UTILITIES AND FACILITIES

OBJECTIVE:

1. To anticipate and provide public utilities which will meet community needs in a timely manner.

POLICIES:

a. Maintain all power and utility systems so as to meet public health and safety standards.
b. Encourage new and expanded power generation facilities to be community planned based on sound land use and environmental planning principles.
c. Assure the availability of power systems and sources that meet public health and safety standards.
d. Locate energy producing plants in areas where they will not create health hazards.

OBJECTIVE:

2. To improve the quality and availability of public facilities throughout Maui County.

POLICIES:

a. Encourage the design of multi-purpose public facilities accessible to all age groups and the handicapped.
b. Continue the development of community centers throughout the County.

Exhibit No. 1

c. Seek improvement in the maintenance and operation of public facilities.

d. Encourage the development of public facilities which will be architecturally and ecologically compatible with their surroundings and foster community development.

V. SOCIAL INFRASTRUCTURE

A. ACCESS TO HUMAN SERVICES

OBJECTIVE:

1. To coordinate through the Maui County Department of Human Concerns the establishment of quick and reliable access to human services.

POLICIES:

a. Coordinate the services of government (Federal, State and County) and private non-profit agencies, in order to insure the quickest and most reliable access to needed services.

B. RECREATION AND OPEN SPACE

OBJECTIVE:

1. To provide high-quality recreational facilities to meet the present and future needs of our residents of all ages and physical ability.

POLICIES:

a. Maintain and upgrade existing recreational facilities to meet community needs.

b. Maintain recreational facilities for both active and passive pursuits.

c. Maintain the natural beauty of recreational areas.

d. Develop facilities that will meet the different recreational needs of the various communities.

e. Develop multi-purpose recreational facilities.

f. Establish a vigorous paid and volunteer maintenance program of County controlled beach rights-of-way and all other recreational facilities.

g. Expand, improve and create new beach rights-of-way, parks, campsites, and other facilities designated for family use.

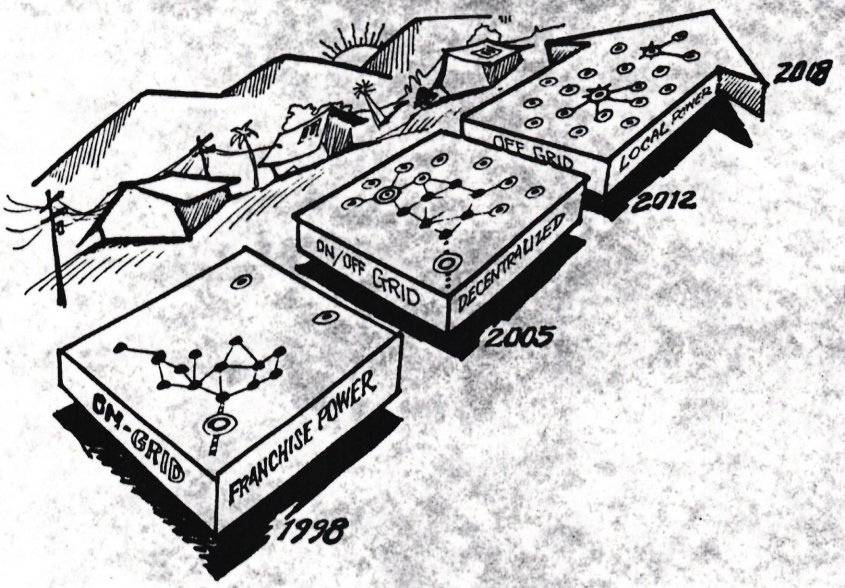
h. Encourage the transfer of under-utilized State and Federal land to the County for public recreation and cultural use.

OBJECTIVE:

2. To provide a wide range of recreational, cultural and traditional opportunities for all our people.

REGIONAL ENERGY INITIATIVES

THE NA MAKANI ENERGY INITIATIVE PUTS FORTH THE RURAL NEEDS OF HAWAII FOR THE NEXT TWENTY YEARS



THE ATTACHED ENERGY PLANNING DOCUMENT SUMMARIZES THE COMMUNITY BASED PLANNING INITIATIVES ASSEMBLED BY A TASK FORCE OF ENERGY EXPERTS AND COMMUNITY STAKE HOLDERS IN NORTH KOHALA

PHASE I
NA MAKANI ENERGY INITIATIVE
sponsored by
PLAN TO PROTECT, INC.

TASK FORCE LEADERS
J.T. POWER, M.D.
KENNETH BOCHE
JIM CHANNON

Exhibit No. 2

PROJECT REPORT

~Na Makani Energy Initiative~

Phase I

[Sponsored by Plan to Protect, Inc.]

Project Coordinators

J.T. Power, M.D.

Kenneth Boche

Jim Channon

PROJECT REPORT
~Na Makani Energy Initiative~
Phase I

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VIII.	ADDENDUM B—PARTICIPANTS*	
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X.	ADDENDUM D—HANDOUTS & FLYERS*	

*[available upon request]

Na Makani Energy Initiative
P.O. Box 682—Kapaau, HI 96755
808.889.5906 (phone/fax)
isf@aloha.net

INTRODUCTION

The ***Na Makani Energy Initiative***, a County funded series of community energy planning forums, held three roundtables on July 1, September 16, and November 18, 1997. Each of the forums focused, respectively, on one of three main areas: 1) energy efficiency and conservation; 2) renewable energy strategies; and 3) action planning. A diverse group of energy experts and community advocates convened on those occasions to discuss options for future energy development in North Kohala. This project, sponsored by Plan to Protect, Inc., a non-profit organization for resource sustainability, was intended to introduce and formalize a community based planning process upon which to build consensus and ongoing community participation. The current report is prepared for the Hawaii County Department of Research and Development, which funded the project.

BACKGROUND

As a result of the North Kohala community's clearly expressed preference to avoid polluting technologies of energy production and to pursue long-term, sustainable solutions to its energy needs into the 21st century, an effort was initiated to engage in a true community based energy planning process. Community members had previously demonstrated a keen intention to pursue community self-determination in these matters.

Following on the unanimous passage, on June 19, 1996, of Hawaii County Council Resolution 317-96—the so-called 'North Kohala Power Resolution' (excerpts below), a group of community advocates applied for and received a grant from the Hawaii County Research and Development Department. This small grant provided an essential next step toward implementing the intent of the Resolution by affording the community the opportunity to explore, in the form of an "energy round table", the full range of practical development options.

Excerpts from Hawaii County Council Resolution—317-96:

> **Now, therefore be it resolved by the Council of the County of Hawaii** that it joins with the citizens of North Kohala to formally request the Hawaii State Legislature and the Governor to actively support an immediate full scale energy conservation education effort, followed by the thoughtful development of appropriate renewable, non-polluting and sustainable energy sources, such as solar, wind and other proven, cost-effective alternative energy technologies, as part of a collective, integrated strategy for a "soft energy path" into the 21st century, in a community-based collaboration with governmental agencies, the local utility and independent power producers.
>
> **Be it further resolved** that the Council supports the creation of a forum to address the above mentioned energy issues and that such a round table discussion would be held in North Kohala, although not limited to issues facing the North Kohala community with regards to alternative energy development.

FORUM PROCESS

An operational steering committee composed of community members was responsible for the planning and implementation of the forum series. This steering committee developed a budget, established procedural format and guidelines, selected participants, and set the schedule and agendas for the three forums (see Addendums A and B). The committee was also responsible for community and media notification of upcoming events (see Addendum D), and live (and weekly repeated tape delay) local public access cable television broadcasts of all of the forums.

The selected format for each of the forums was a moderated presentation and discussion process. Opportunity for community input was provided for by the inclusion of a question and answer session, including on site call-in phone access for home viewers. Each of the three forums was two hours in length.

PARTICIPANT SURVEY

During the third forum, which was focused on developing an action plan, the attendees were asked to participate in a survey intended to elucidate trends regarding future energy development in North Kohala. The procedure used was a modified 'delphi technique', which is deemed reliable when the sample is both qualified and broad. The participants met those specifications.

The collective trends were subsequently summarized in a graphic overview to establish general guidelines for the plan under development for North Kohala (see Addendum C). The trends elaborated through this process are projected to be pertinent for all outlying bioregions in the state of Hawaii, with utilization patterns contingent upon resource availability at specific locations.

It is clear that regional power preferences, as determined by this survey, will be moving from completely centralized sources to completely independent sources within the first fifteen years of the next century. The interim phase will manifest customers who are currently "on the grid", but who are progressively adding to their independence with an array of new, locally purchased technology. They are referred to as "on/off grid" customers. Over the long range, "micro technology" is anticipated that will fully establish the independent, "off grid" customer. Ideally, during the interim, independent power producers will initiate a regional interest in solar, wind and hydro power, likely in that order.

In the short range, restrictive legislation and the community's lack of education about alternatives are the two greatest challenges. Local initiatives for education could include solar workshops, free energy audits, a legislative information service, and the introduction of scale model solutions for display at local gathering places.

ACTION PLAN

A review of the transcripts of the three forums, revealed a number of possible actions within specific areas of influence. Each of these actions is seen as a potential component to the masterplan for energy development in North Kohala. As more of these actions are

undertaken, the community will become more energy self-sufficient, with the ultimate goal of realizing energy independence and sustainability.

- **Utility Management Recommendations:**

  - **ACTION**: HELCO has agreed to monitor total electrical demand for North Kohala. This will provide a baseline from which to benchmark future changes in energy demand from the grid.

  - **ACTION**: HELCO has agreed to institute a small trial of "time of use" electrical rates (test program with 50 homes). ***Na Makani*** proposes to evaluate community interest in this idea during Phase II of the project.

- **Legislative Action Recommendations:**

  - **ACTION**: The State legislature should extend the solar and renewable energy income tax credits. This is the single most important action that the legislature can do to support renewable energy development. This action is known to be a net benefit to the State's economy.

  - **ACTION**: The State legislature should pass a true "net metering" bill. This would allow excess electricity generated from renewable sources to be "traded" for electricity generated by utilities at times when renewables are unavailable. This would allow optimum sizing of grid inter-tied renewable sources.

  - **ACTION**: The State legislature should require that the Department of Health's Clean Air Fund be utilized to implement cost-effective energy-efficiency and renewable energy development (such as solar water heaters, energy-efficient lighting in State facilities, etc.) that will defer the need for new fossil fuel generating capacity.

  - **ACTION**: The State legislature should empower the counties to provide property tax-exemptions for renewable energy facilities. Property taxes on the value of renewable energy facilities are an additional cost that renewable energy facilities must bear. (HELCO's fossil fuel fired facilities are tax-exempt.)

  - **ACTION**: Hawaii County Government should enact the Hawaii Residential Model Energy Code.

  - **ACTION**: Hawaii County Government should enact diversion credits that represent the real costs of landfilling green wastes. These diversion credits could be utilized by renewable energy developers to supplement revenues from energy sales. These revenues can substantially improve the economics of renewable energy projects.

- **ACTION**: Build alliances and communicate recommendations regarding this agenda to State and County lawmakers.

✦ **PUC Competition Docket Recommendations:**

- **ACTION**: Allow wholesale and retail wheeling to permit direct service between renewable energy facilities and customers. Provide renewable energy developers with reasonable terms and conditions regarding access, access charges, etc. Independent power producers should be allowed to transmit and distribute renewable energy to consumers who are willing to pay the price.

- **ACTION**: Allow competition for operation and/or ownership of all or parts of the electric grid by community non-profits or for-profit enterprises. Perhaps a resource rich community such as North Kohala could provide power cheaper by a community owned or operated utility grid. If rules permitted, a business plan might show that the whole North Kohala portion of the grid could be operated from energy sources indigenous to the district while providing a wider range of customer choice about sources of power, as well as lower prices. This would also provide a better business climate for emerging companies and technologies.

- **ACTION**: Allow on site electrical generation by underground gas pipelines. Customers could be provided gas by independent power producers through underground gas lines which run fuel cells located on the customer's property. Would this be allowed under present or future rules? The gas could be made from renewable sources, integrating "waste" management into the operation. Thus customers would have a wider variety of choices about, and perhaps lower prices for, their electricity.

- **ACTION**: Allow developers and/or owner power co-ops to provide power to individual residences within new developments. This puts less demand on the grid, whose present owners are planning new oil-fired sources to meet future demands. And it provides niche markets for village scale integrated renewable systems, which may be cost-effective today. Integrating waste-management, agricultural production, and power production within a development as a way to create all power on site and export no wastes is a goal of forward-thinking land developers. Real estate developers can then offer their potential customers greater choice in how their electricity is made as well as in what kinds of building materials and resource-efficient designs are employed in a project. Innovation in development, housing, and energy utilization would emerge.

- **ACTION**: Allow communities to vote to have a choice of power providers based on better service, e.g. underground lines, lower prices, better reliability, renewable energy sources, etc.

- **ACTION**: Build alliances and communicate these recommendations to the PUC and Consumer Advocate.

- **Community Outreach:**

  - **ACTION**: Put "energy action plan" on-line (www.kohala.org; Maui-Tomorrow; www.kohala.net; ISF website). [No Expense]

  - **ACTION**: Write articles about this Action Plan for Ka'u Landing, West Hawaii Today, Kohala Mountain News, and other publications. [No Expense]

  - **ACTION**: Evaluate community interest and need for the following action items, probably through the use of a bulk mailing to the entire community, including a residential energy questionnaire for return to ***Na Makani***. [Utilize County Phase II funds to implement this action.]

  - **ACTION**: Provide free residential and commercial energy surveys. Kohala Research shows that 42.5% of Kohala residents (1990 census: population = 4,800; 3.2/house = 1,500 households X .425 = 637.5 households) want these surveys. At $25 per survey, this is $15,750. [Fund this action through a grant from CBED or other appropriate funding source.]

  - **PROPOSED ACTION**: Make available a residential efficiency package, including water heater jacket; compact fluorescent lamps; high-efficiency showerheads; faucet aerators; hot water pipe insulation; electric water heater timers; on-demand water heaters. [Fund this action by combining HELCO's residential efficiency program with money from users to help pay for components.]

  - **PROPOSED ACTION**: Make available a residential solar (solar hot water and photovoltaic) package, including collectors, tanks, and other hardware.

  - **ACTION**: Evaluate each component. Where do we obtain items, how much do each of these measures cost, and what are their life-cycle costs or other profitability measures? [Fund evaluation of components with County Phase II funds.]

  - **ACTION**: Evaluate most reasonable ideas and hardware. [Fund evaluation of options with County Phase II funds.]
    - Bulk installation of HELCO systems.
    - Bulk buy of only collector and/or tank or pre-heater. (Combine with a workshop or other means to get systems installed.)
    - Bulk buy of Solar Development, Inc.'s low-income solar water heater systems.

  - **ACTION**: Evaluate "solar workshop" options for building and/or installing low-cost solar systems. Examples follow. [Fund evaluation of options with County Phase II funds.]

- Crystal City, Texas—$85 collectors.
- North Carolina Alternative Energy Corporation—$60 window box collectors and $300 solar water heaters.
- Colton, California—youth build and install solar equipment. (Kohala Intergenerational Center?)
- DBEDT's "Do It Yourself Water Heater Construction and Installation Program"

✦ **Rebuild America Program:**

➢ **ACTION**: Become a partner in this Department of Energy program (through 'Rebuild Hawaii Island' partnership with Hawaii County and HELCO). The community can access information on energy efficiency and renewable energy products and services, case studies and peer exchange, technical assistance, sustainable development program assistance, and financing options. DOE also provides assistance brokering projects. The community would gain credibility for funding and other purposes. ***Na Makani*** will prepare a separate Action Plan for participation in this program.

✦ **Green Enertopia:**

➢ **ACTION**: Become a partner in this program, whose purpose includes the establishment of national centers for enhancing public education, expanding technology transfer, and developing incentives for clean energy systems. The community would gain both technical assistance and credibility for funding and other purposes.

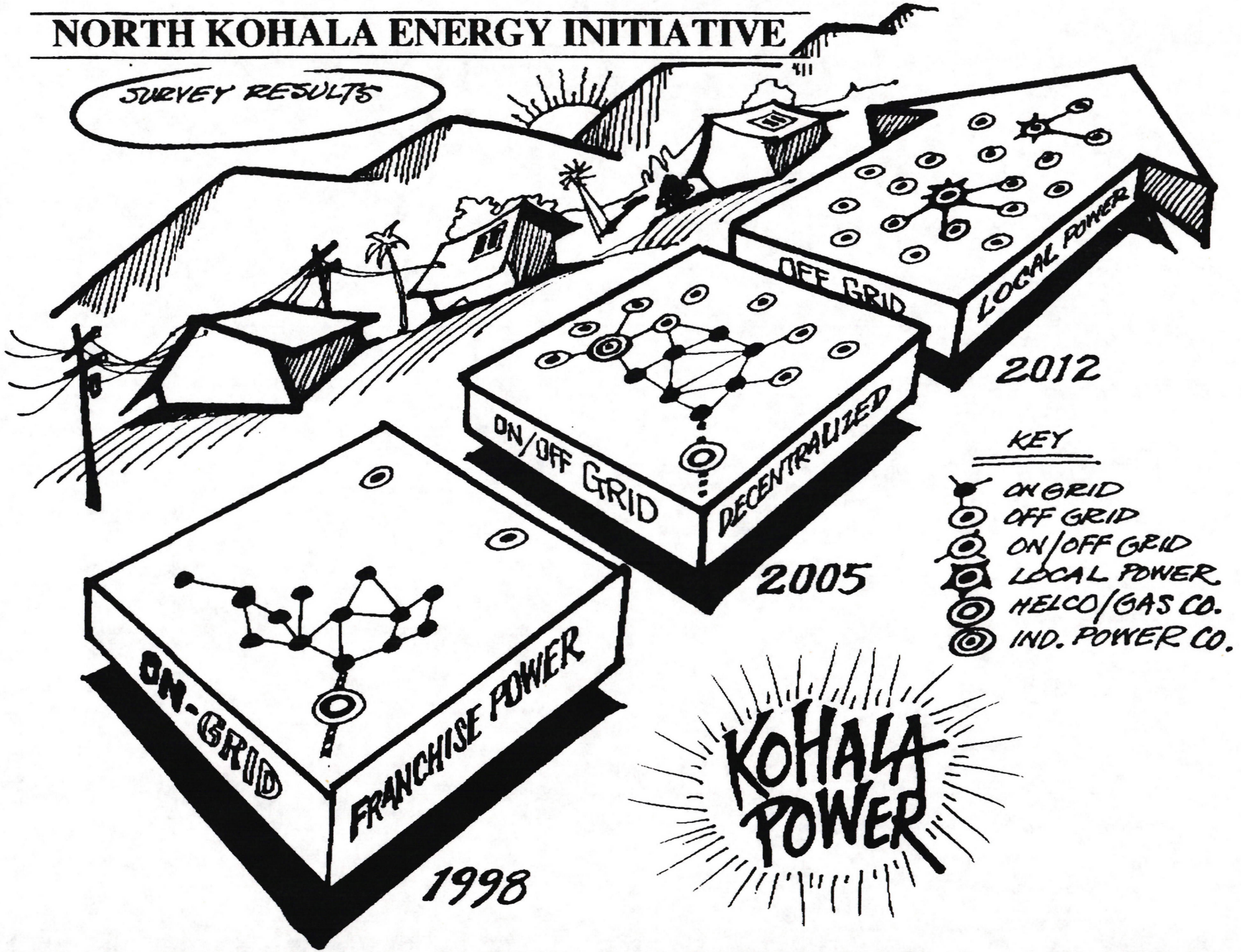
✦ **Entrepreneurial Opportunities:**

➢ **ACTION**: Pursue these as part of the community's broader interests, and funding and technical assistance requests.

SUMMARY

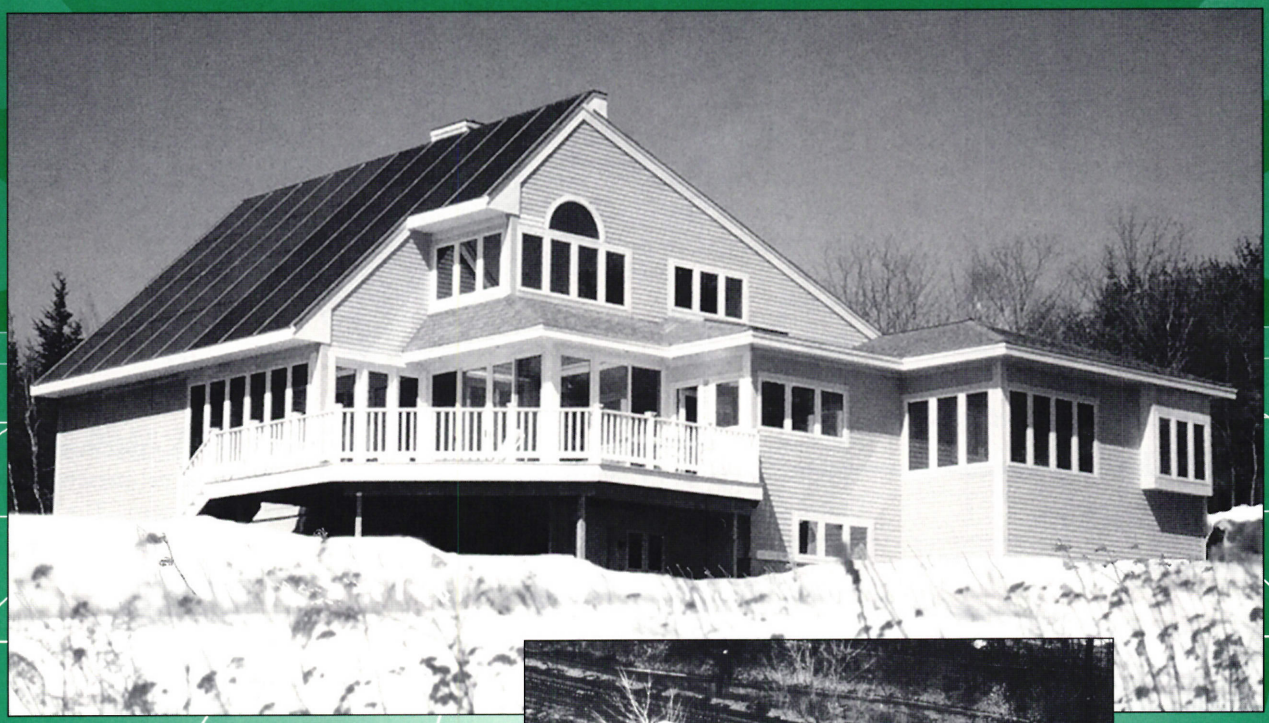
The ***Na Makani Energy Initiative*** project proposed to provide a vehicle for the community to envision and articulate its preferred energy future, and to develop a preliminary action plan as a cornerstone for energy self-sufficiency for the community of North Kohala. The project was timely and important because it provided an impetus for long range sustainable energy planning and development on the Island of Hawaii. Viable planning strategies derived from this project can now be shared with other communities, enabling them to make informed choices suitable for their prevailing conditions and in alignment with their intended purposes. The final true measure of success for this project lies in the degree to which these communities can engage themselves in this process and self-determine their future on the "soft energy path".

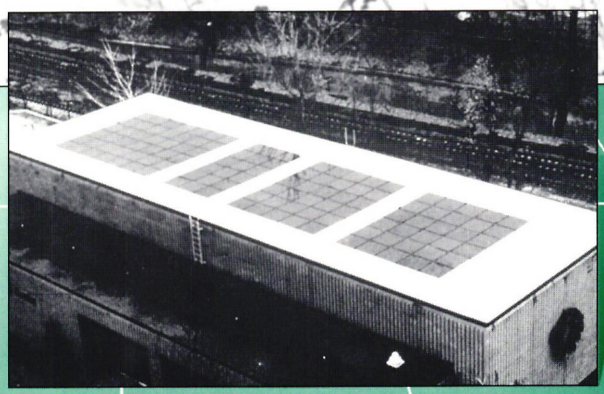
NORTH KOHALA ENERGY INITIATIVE



CUSTOMER-SITED PHOTOVOLTAICS:

Focusing on Markets That Really Shine





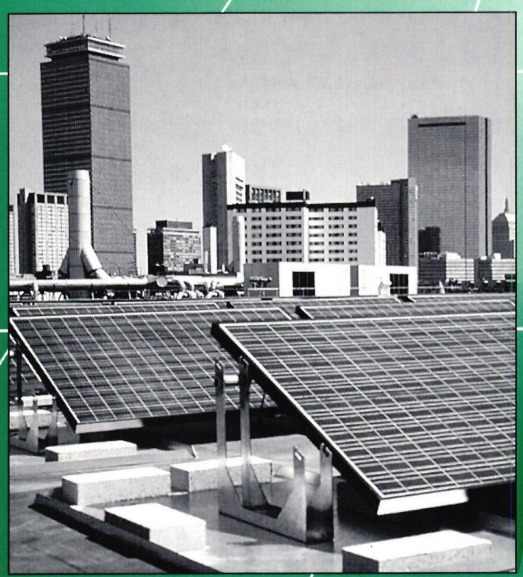




Exhibit No. 3

A STUDY HIGHLIGHTING THE BEST MARKETS IN THE UNITED STATES FOR GRID-CONNECTED PHOTOVOLTAIC SYSTEMS

PV Now!



Photovoltaics are cost-effective at today's prices of about $6 to $7 per watt.

Today—yes, today—cost-effective markets exist for **customer-sited photovoltaics (CSPV)**—that is, grid-connected PV applications located at residential and commercial customer sites.

You don't need to wait for the future to find markets for customer-sited photovoltaics that are cost effective. Such markets exist now, and we have identified many others that have near-term promise. Exploiting these economic markets will hasten the commercialization of PV power that is connected to the utility grid.

CSPV systems have many unique attributes and offer incentives to utility customers, who are the end users of electricity.

These attributes and incentives include:

- Compensation for power at retail electric rates
- Tax credits
- Financing, leasing, and depreciation options
- Net-metering options and/or rate-based incentives
- Building credits for architectural applications
- Willingness to pay for clean power and innovation
- Quality of solar resource and customer load match
- Progressive state government, regulatory, and utility support.

The best niche markets are the locations that have the best combinations of these attributes and incentives.

Targeting the Markets

Following a two-step approach, we have identified target CSPV markets in the United States.

Step One: On a state-by-state basis, identify attributes such as PV electricity production, utility electric rates, and solar tax incentives. See the table on the back page for detailed information.

Step Two: On a state-by-state basis, conduct a financial cash-flow analysis based on data from Step One for a base-case CSPV application. This analysis determines the **break-even PV system price**—the price at which the net present value of cash flows goes to zero. The higher this price, the more economic the location is right now.

We defined the base case as a new residential development that incorporates 1-kilowatt rooftop PV systems. Our assumptions are that the PV system is included in the homeowner's mortgage (a 30-year, 90%-debt loan with a fixed interest rate of 8%).

Hawaii—Ready for the PV Marketplace

Let's look at the proposed benefits to a homeowner who finances a $7500 ($7.50 per watt) PV system on the big island of Hawaii. The residential electric rates here are about 17 cents per kilowatt-hour. The chart to the right shows the year-by-year cash flow—both positive and negative—together with the net cumulative cash flow. *The customer has no out-of-pocket costs from the very first year forward*—that is, the net cash flow is immediately positive. This situation is a very compelling case for marketing PV systems in Hawaii.

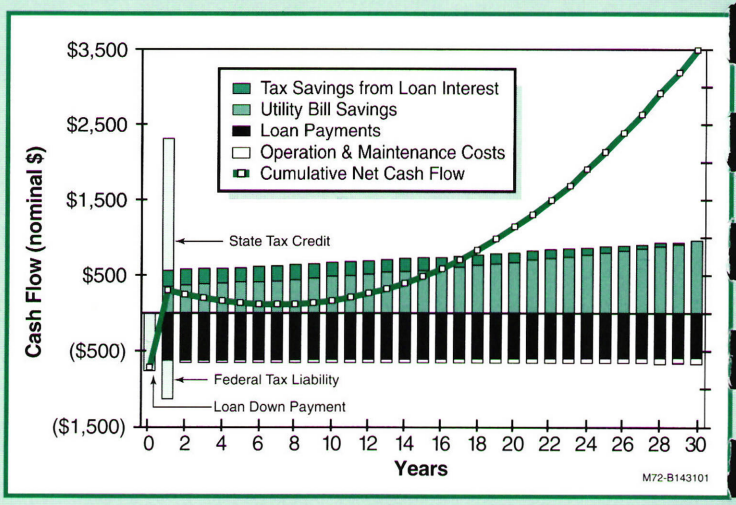


Figure 3. 30-year cash flow for $7500 ($7.50 per watt) residential PV system in Hawaii. The cash flow is always positive after the first year.

And the Winners Are...

We ranked the states by break-even PV system price and identified three market tiers. The best markets are in the southwest and northeast, with the top 5 CSPV niche markets being **Hawaii, California, Arizona, New York,** and **Massachusetts.** Their break-even PV price was between $4.30 per watt and $7.50 per watt.

A 4% low-interest loan would boost this range by 40%—to $6.20/W–$10.30/W. In either case, PV is cost-effective at today's prices of about $6-$7 per watt.

Utility rates and PV capacity factor are a good first-order screen for targeting markets. An added incentive, such as a tax credit, can catapult a market contender. As an example, compare North and South Carolina. Each state has almost identical utility rates and PV capacity factor, but North Carolina's solar tax credit moves its market ranking to 6, while South Carolina ranks 16.

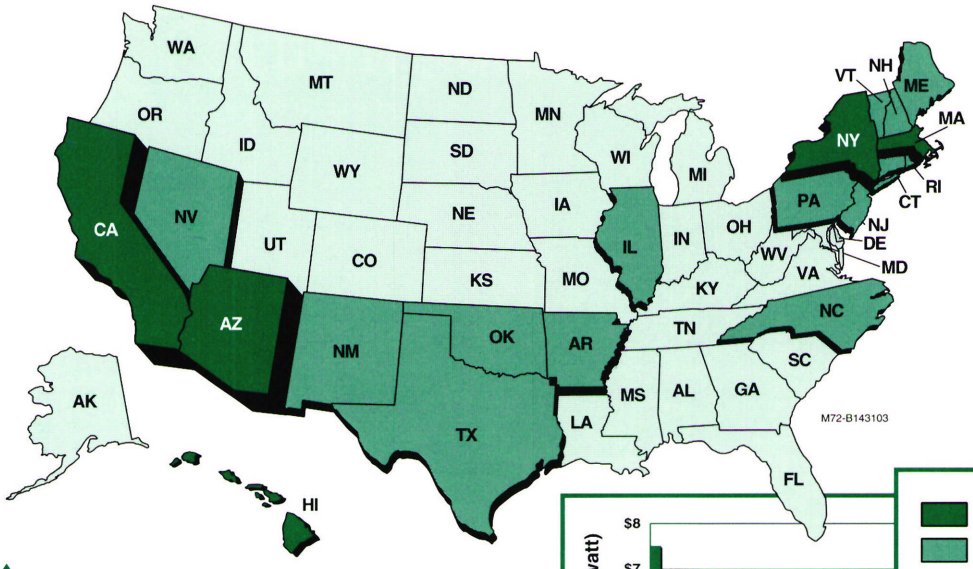


Figure 1. Three market tiers are identified. The best markets are in the southwest and northeast.

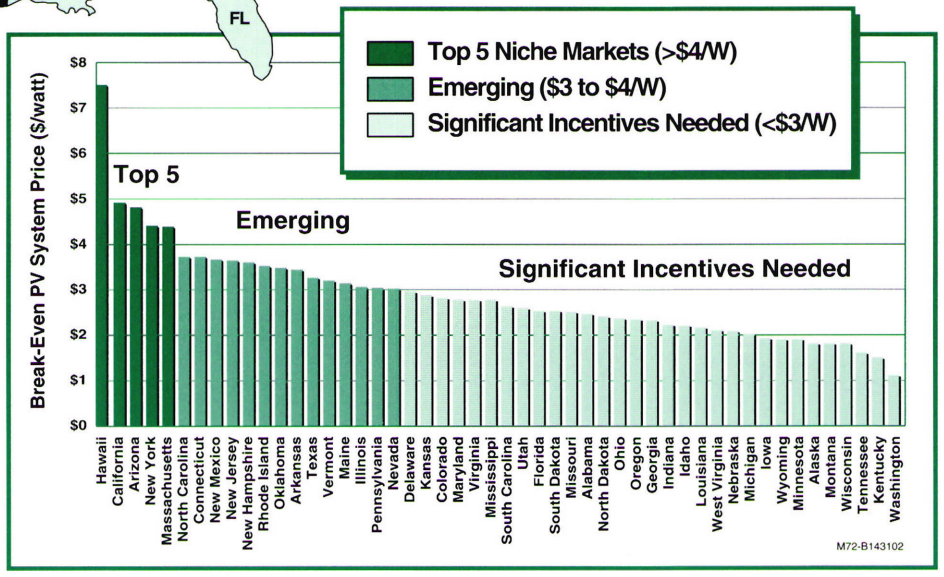


Figure 2. States ranked by break-even PV system price.

And as the table below shows, the Big Island is not the only place where PV systems make sense. The listed electricity rates and break-even PV prices especially highlight Kauai as a prime candidate for marketing PV systems.

Island	Electricity Rate (¢/kWh)	Break-Even PV Price ($/W)
Kauai	20.0	$9.70
Hawaii-Big Island	17.0	$8.40
Maui	13.8	$7.00
Oahu	12.3	$6.40

PV economics for residents in Hawaii.







Guiding U.S. Commercialization

Grid-connected PV applications are *cost-effective today,* especially in Hawaii. And our analytic approach has highlighted the best markets for grid-connected PV systems across the United States.

	Market Ranking	Res. Rate (H/M/L)	Capacity Factor (H/M/L)	Res. Tax Incentive	Com. Tax Incentive	Net Metering	Res. Rate (¢/kWh)	Com. Rate (¢/kWh)	Capacity Factor (%)	Com. ELCC (%)
Alabama	31	M	M				8.2	6.9	18.1	61
Alaska	45	H	L				10.1	8.5	11.4	N/A
Arizona	3	M	H	1		Yes	9.6	8.6	22.8	65
Arkansas	13	H	M				11.0	7.1	18.1	76
California	2	H	H			Yes	13.1	10.3	20.9	64
Colorado	22	L	H				7.6	5.8	21.9	51
Connecticut	7	H	M			Yes	12.5	9.9	17.1	46
Delaware	20	H	M				10.1	7.0	17.1	57
Florida	28	M	M				8.5	6.6	18.1	48
Georgia	35	L	M				7.9	7.5	17.8	68
Hawaii	1	H	H	2a	2b	Pending	15.2	12.0	22.5	50
Idaho	37	L	H	3		Yes	5.3	4.3	20.0	32
Illinois	17	H	M				10.3	8.1	17.5	68
Indiana	36	M	L				8.5	6.0	16.2	57
Iowa	42	L	M			Yes	6.9	6.4	17.5	69
Kansas	21	M	H				8.5	6.7	20.0	78
Kentucky	49	L	L				6.1	5.3	16.2	41
Louisiana	38	L	M				7.2	7.2	18.5	71
Maine	16	H	L			Yes	12.2	9.3	15.2	24
Maryland	23	M	M				9.6	7.1	17.1	54
Massachusetts	5	H	M	4a	4b	Yes	12.6	9.3	17.3	49
Michigan	41	M	L				8.5	8.3	14.7	67
Minnesota	44	L	L			Yes	7.4	6.1	16.2	56
Mississippi	25	M	M				9.0	7.3	18.2	50
Missouri	30	M	M				8.4	6.4	18.1	71
Montana	46	L	M				6.3	5.2	18.1	54
Nebraska	40	L	M				6.8	5.6	19.0	77
Nevada	19	M	H				8.0	6.3	22.3	71
New Hampshire	10	H	L			Yes	13.6	10.4	15.2	30
New Jersey	9	H	M				12.2	9.3	17.1	75
New Mexico	8	M	H				9.2	8.3	23.0	45
New York	4	H	M			Pending	14.5	11.2	17.1	60
N. Carolina	6	M	M	5a	5b		8.6	6.6	17.6	52
N. Dakota	32	L	M	6a	6b	Yes	7.5	6.5	17.6	49
Ohio	33	M	L				9.8	7.6	14.7	53
Oklahoma	12	L	H	7a	7b	Yes	7.8	6.1	20.0	74
Oregon	34	L	M	8a	8b		5.5	4.9	17.1	16
Pennsylvania	18	H	L			Yes	12.0	8.5	15.0	44
Rhode Island	11	H	M			Yes	12.1	10.1	17.1	59
S. Carolina	26	M	M				8.8	6.2	17.8	43
S. Dakota	29	M	M				8.5	6.8	18.1	43
Tennessee	48	L	M				6.1	6.5	17.1	30
Texas	14	M	H		9	Yes	9.1	6.7	20.9	68
Utah	27	L	H				7.0	6.0	22.3	27
Vermont	15	H	L			Yes	12.5	9.2	15.0	32
Virginia	24	M	M				9.6	6.2	17.1	47
Washington	50	L	L				5.5	4.3	14.3	8
W.VIrginia	39	M	L				8.1	5.6	16.2	45
Wisconsin	47	L	L			Yes	7.5	5.9	15.2	59
Wyoming	43	L	H				6.0	5.2	20.0	22

Furthermore, policy instruments—such as buy-downs of loan interest and capital cost—are effective mechanisms for reaching cost-effectiveness in the top U.S. markets. An example is the TEAM-UP (Technology Experience to Accelerate Markets in Utility Photovoltaics) project, funded in part by the U.S. Department of Energy.

The results shown in this brochure are good approximations for commercial customers. The added commercial benefits of a 10% federal tax credit and depreciation are somewhat offset by typically shorter loan terms that are less leveraged by debt and by more stringent rate-of-return and payback requirements.

The bottom line is that this analysis of the best niche markets for grid-connected PV systems should help guide commercialization efforts. ■

◀ State-by-state attributes and incentives for grid-connected PV.

Table Notes: Market Ranking by break-even PV price; Res. Rate: High (>10¢/kWh), Medium (8–10¢/kWh), or Low (<8¢/kWh). Capacity Factor: High (>20%), Medium (17%-20%), or Low (<17%). State Tax Incentives as follows: (1) 25% TC, $1,000 Max (2a) 35% TC, $1,750 Max (2b) 35% TC, no Max (3) 100% TD over 4 yrs, $5,000/yr Max (40% yr 1, 20% yrs 2, 3, & 4) (4a) 15% TC, $1,000 Max (4b) 100% TD, no Max (5a) 40% TC, $1,500 Max, can carry over 5 yrs, (5b) 35% TC, $25,000 Max, can carry over 5 yrs, (6a & b) 5% TC per yr for 3 yrs, (7a) 30% TC, $25,000 Max, can carry over 5 yrs, expired '95 - extension pending for 7a&b (7b) 20% TC, $150,000 Max, can carry over 5 yrs (8a) 1996 and 1997; 48¢/kWh TC, $1,200 Max; 1998-2001; 40¢/kWh, $1,000 Max (8b) 35% TC over 5 yrs (10% yrs 1 & 2, 5% yrs 3, 4, & 5) (9) 100% TD on "taxable capital" or 10% TD from "taxable earned surplus." TC = Tax Credit; TD = Tax Deduction; Max = Maximum tax incentive allowed; ELCC = Effective load-carrying capacity.

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Source: Howard Wenger (Pacific Energy Group); Christy Herig, Roger Taylor, Patrina Eiffert-Taylor (NREL); and Richard Perez (SUNY) "Niche Markets for Grid-Connected Photovoltaics," May 1996.





Produced for the U.S. Department of Energy
1000 Independence Ave., S.W.
Washington, D.C. 20585
by the National Renewable Energy Laboratory, a DOE national laboratory.

DOE/GO-10097-371
DE97000220
March 1997

Special thanks to James Rannels, DOE's Office of PV and Wind Technologies, for supporting this work.

Photographs appearing throughout this brochure: Cover–PIX04470/Lord house (Maine); PIX04471/Tuckahoe Community Center (New York); PIX04478/Ell Student Center, (Massachusetts); PIX04473/Solar townhouse (Maryland). Inside left–PIX04474/FIRST house (New Jersey); PIX04475/Union of Concerned Scientists (Massachusetts). Inside right–PIX04476/Olympic Natatorium entry canopy (Georgia); PIX04477/Energy Resource Center (Georgia). Back– PIX04472/Olympic Natatorium Complex (Georgia); PIX04479/Solectrogen house (California).

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Invited commentary for *Energy Policy* 1996 special issue on the future of DSM 19.VIII.95 revision

Negawatts: Twelve Transitions, Eight Improvements, and One Distraction

AMORY B. LOVINS, DIRECTOR OF RESEARCH
ROCKY MOUNTAIN INSTITUTE

Twelve fundamental transitions are underway in the efficient use of electricity.[1] Six are well along, while the other six remain as a central challenge for the next decade and beyond. Once they are accomplished, the resulting economically efficient use of electricity will reduce by at least severalfold the quantity of electricity needed to provide present services with unchanged or improved quality.[2] This major substitution will be caused by economic fundamentals[3]; the negawatt debate is simply a subtext about whether they are to be recognized or suppressed.

The first six transitions are familiar to practitioners:

1. *From economic theorists' paradise to the real world.* It is now widely, though far from universally, recognized that market failures in buying electrical productivity are real and important. Indeed, some analyses[4] suggest that in certain key arenas, market failure can be more important than market function: the perverse incentives seen by all ~25 parties in the real-estate process so systematically reward inefficiency and penalize efficiency that the United States has already misallocated, at marginal cost, a sum approaching $1 trillion just to air-conditioning equipment and power supplies to run it.[5]

   One of many striking empirical examples of market failure was revealed by Dow/Louisiana Division's implementation of nearly a thousand energy-saving and waste-reducing projects during 1981–93, with audit-confirmed returns on investment *averaging over 200% per year*—falling to double digits, 97%, only in a single year—and with the savings tending in recent years to become *bigger and more profitable* even as real energy prices tended to decline, because the practitioners' learning curve outran the depletion of the "negawatt" resource. Market theory would suggest that such enormously profitable savings should have been automatically achieved much earlier by a sophisticated firm in a cost-conscious industry: there shouldn't have been thousand-dollar bills lying all over the factory floor. But Dow's Ken Nelson found that not only was the floor figuratively

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[1] "Efficiency" in this article is used in the engineering sense—physical services (such as light, torque, or heat) delivered per unit of electricity consumed. In contrast, economists often construe "energy efficiency" to mean "economically efficient use of primary energy to produce aggregate economic output." This profoundly different semantic universe has created much of the divergence between *e.g.* the World Bank and its critics.

[2] A.P. Fickett, C.W. Gellings, & A.B. Lovins, "Efficient Use of Electricity," *Sci. Amer.* 263(3):64–74 (Sept. 1990); A.B. & L.H. Lovins, "Least-Cost Climatic Stabilization," *Ann. Rev. En. Envt.* 16:433–531 (1991); E SOURCE (Boulder CO 80302-5114), *Technology Atlas* series and bimonthly supplements, 1992– ; A.B. Lovins & W.D. Browning, "Negawatts for Buildings," *Urban Land* 51(7):26–29 (July 1992); A.B. Lovins, "The Negawatt Revolution," *Across the Board* (The Conference Board, NY), September 1990, pp. 18–23; E.U. von Weizsäcker, A.B. & L.H. Lovins, *Faktor Vier: Doppelter Wohlstand—halbierter Naturverbrauch*, Droemer Knaur (München), 1995; and other publications, some detailed and technical, of Rocky Mountain Institute (Snowmass CO 81654-9199).

[3] Efficient use of electricity is far cheaper than making more of it[2], usually even at short-run marginal cost (*infra*), and the gap is widening. As customers figure this out, they will naturally want to buy less electricity and more efficiency. The only question is who will sell them the efficiency. Most utilities have figured out (although lately some have temporarily forgotten, as discussed below) that it is a sound business strategy to sell customers what they want before someone else does. Utilities' choice is hence between participation in the negawatt market and obsolescence.

[4] A.B. Lovins, *Energy-Efficient Buildings: Institutional Barriers and Opportunities*, E SOURCE (Boulder CO), SIP-2, November 1992; U.S. Congress, Office of Technology Assessment, *Building Energy Efficiency*, May 1992; M.D. McMahon, E. Hirst, J.G. Koomey, J.E. McMahon, & A.H. Sanstad, *Energy Efficiency, Market Failure and Government Policy*, LBL-35376 (Lawrence Berkeley Laboratory) and ORNL/CON-383 (Oak Ridge National Laboratory), 1994.

[5] *I.e.*, that much capital (two-thirds of it for 200 GW_p of supply) would have been saved if the buildings had instead been optimally designed to deliver the same or better comfort in the cheapest way: D. Houghton *et al.*, *The State of the Art: Space Cooling and Air Handling*, E SOURCE (Boulder CO), 1st ed., 1992, at pp. xviii, 7–8, 36–40.

Exhibit No. 4

carpeted in them, but as soon as he picked one up, he found two more underneath. Or to use another metaphor: not only did he find profuse low-hanging fruit, but the more he picked, the heavier with new fruit the boughs became. This is now a common experience for advanced practitioners in almost any electricity-using facility. Theoretical economists should get used to it. (PS: Nelson retired in 1993; his coordinating group was disbanded; data-tracking ceased, so management's claims that the program still lives cannot be validated. Apparently not even Dow's adjacent Texas Division went very far in adopting similar practices, because it had no corresponding internal "champion.")

2. *From supply extrapolation to end-use/least-cost.* Modern utilities no longer project aggregated demand and build to meet it. Rather, they appreciate that future demand for electrons is not fate but choice, and should represent market clearing (or its emulation by other means) between marginal supply of more electrons and marginal improvement in the productivity of converting electrons into end-use services. Modern utilities therefore ask how much of which specific end-use services customers may want, such as hot showers and cold beer, then seek to enable customers to meet those needs in the cheapest way through a least-cost mix of energy productivity and energy supply, optimizing the scale and quality of supply to the task's requirements. This is the essence of the Integrated Resource Planning required by the U.S. National Energy Policy Act 1992, §111, and of the principles unanimously adopted in 1989 by the National Association of Regulatory Utility Commissioners, although it can certainly be done in a decentralized and market-oriented fashion rather than by planners.

3. *From residential to all sectors.* Almost all utilities have found that although large and attractive residential opportunities remain, the biggest and cheapest savings are largely in the commercial and industrial sectors. These tend to dominate programs driven by economic rather than political criteria.

4. *From load management to efficiency.* Load management saves only generating and grid capacity. End-use efficiency saves capacity, usually more than it saves energy, but it *also* saves energy (hence fuel) and pollution. It's better to have all three benefits than just one. Load management is thus best seen, in general, as a useful adjunct to prior comprehensive efficiency efforts, not as the dominant or only form of demand-side investment.[6] Real-time pricing does not vitiate and may well strengthen this conclusion.

5. *From claimed to measured savings.* Many if not most utility efficiency programs now use the highly developed evaluation methods that can check cost-effectiveness and improve design. Any system without feedback is stupid, by definition, and any program without some sort of evaluation is probably suboptimized.[7]

6. *From sticks (exhort but punish efficiency) to carrots (reward efficiency).* Modern utilities and utility regulators understand that "sticks painted orange"[8] are no substitute for juicy carrots. So long as electricity prices are formed in a way that ties utilities' profits to how much energy they sell and that gives utility investors no share of the savings the utilities achieve, utilities will be understandably averse to investing in efficient end-use even when it's cheaper than just *running* existing thermal power plants. Such societally silly incentives prevail virtually worldwide except for about a half-dozen of the United States, which in various ways decouple utilities' profits from their sales volumes and let them share in the savings they create for their customers. Absent such fundamental reform of incentives, enormous misallocations of utilities' capital are both encouraged and guaranteed, even with such minor regulatory palliatives as lost-revenue adjustments or rate-of-return kickers.

This is not to say that all controversy over these matters has vanished. On the contrary, a few critics continue to infer from some specific and apparently costly programs that electric efficiency programs *in general* do or must have

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[6] This article avoids the catch-all term "DSM" (demand-side management). It was invented by Clark Gellings at EPRI, which serves many diverse masters, to embrace *any* action that affects demand, whether by increasing or decreasing it or by changing its temporal pattern. A term so broad is hardly unambiguous enough to be helpful.

[7] That said, the voluminous evaluations provided by large industry that has sprung up to jump through regulatory hoops—evaluations sometimes costing more than the programs being evaluated—often seek greater precision than is necessary, desirable, or valid, and may rest on shaky theoretical grounds: "free riders," for example, deserve far *less* attention than they have received (A.B. Lovins, "Apples, Oranges, and Horned Toads," *El. J.* 7(4):29–49 [May 1994], at p. 37 and its nn. 5–6, and E. Hirst & J. Reed, *Handbook of Evaluation of Utility DSM Programs,* ORNL/CON-336, Oak Ridge National Laboratory [Oak Ridge TN], 1991).

[8] This phrase is Steve Wiel's when he was a Nevada Public Service Commissioner.

poor cost-effectiveness.[9] An enormous and often sophisticated literature on program evaluation, *e.g.* in the annual Chicago proceedings, shows the contrary, as do many helpful compilations comprising large numbers of programs.[10] For example:

- a survey of careful evaluations performed on 158 California DSM programs or program segments found measured savings equal to 93–112% of predicted savings[11];
- the CPUC's Division of Ratepayer Advocate found that during 1991–94, the entire DSM portfolio of all three major California investor-owned utilities saved electricity at an average program cost that fell from about 2.8 to 1.9 current ¢/kWh (Southern California Edison Company was the cheapest, falling from 2.6 to 1.2¢/kWh and averaging 1.7¢/kWh)[12]; and
- the CPUC itself found $1.9 billion in *net* benefits from those programs during 1990–93 (equivalent on the same basis to $2.2 billion through 1994, corresponding to $1.5 billion separately found for New York State).[13]

However, even the most rigorous and independent evaluation is useless if critics reject it, often without even reading it, as obviously "biased" by the evaluators' desire to continue to be hired to do evaluations. (On this tendentious basis, no financial accounts of public companies should be accepted either.) Few critics of efficiency programs have taken the responsibility to acquaint themselves with the evaluation literature; if they had, they would hardly argue simultaneously that evaluation must be done, has not been done, has been done, and cannot be trusted.

These simmering disputes about cost-effectiveness, though they continue to obscure policy discussions, are by now largely confined to the uninformed and the ideologically motivated. Whether at the highest levels of aggregation, like EPRI and EIA compilations of total investment and savings each year, or at the most program-specific level, nearly all utility investments in electric efficiency beat long-run marginal supply cost by manyfold, and most—the main exceptions being some residential shell improvements—also beat short-run marginal supply cost. However, the critics do have a point: most utility efficiency programs, even if cost-effective, could be far *more* cost-effective if both their technical content and their mode of delivery were improved. That critique, which I have been advancing for the past couple of decades, is today more true than ever, even for the best-regarded utility efforts, and lies at the heart of the six new transitions that now challenge practitioners:

7. *From fragmented measures to integrated packages.* Most designers design, most clients buy, most vendors sell and install, most utilities reward, and most regulators analyze and require efficiency improvements *component by component*, requiring each part separately to meet a marginal cost-effectiveness test based on energy savings alone. This slice-and-dice approach is now known to yield electrical savings *severalfold smaller and costlier* than they would be if obtained as an integrated package of measures credited with a wider set of tangible, carefully measured benefits. This is because successive measures applied to a given technical system are *not* independent of each other, but often strongly interactive, and because the interactions often yield important new benefits, especially by making costly equipment smaller, simpler, cheaper, and even unnecessary. For example:

    - In Pacific Gas and Electric Company's "ACT²" experiment (the Advanced Customer Technology Test for Maximum Energy Efficiency), a new house was built in Davis, California, with no heating or cooling equipment, yet with superior comfort despite ambient temperatures up to 40°C design and 45°C peak. Neglecting occupant-supplied plug loads, all the major uses—space and water heating, space cooling, re-

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[9] Serious problems in perhaps the most prominent such contention are surveyed by Lovins, "Apples, Oranges, and Horned Toads," *op. cit. supra*—which also agrees that most programs cost much more than optimized ones would.

[10] *E.g.*, S. Nadel, *Lessons Learned*, N.Y. State Energy Res. & Devel. Authority 90-8 (American Council for an Energy-Efficient Economy, Washington DC, 1990), or the very thorough 1994 evaluation of California programs at the behest of that State's Public Utilities Commission (see CPUC Decision 93-09-078, 17 September 1993).

[11] M. Brown & P. Mihlmester, "Summary of California DSM Impact Evaluation Studies," 11 August 1994 report to California DSM Measurement Advisory Committee. The results are from 1990–92.

[12] June 1995 compilation by Peter Miller, Natural Resources Defense Council (San Francisco). Costs include program outlays and administration, shareholder incentives, measurement and evaluation, and free riders, but not free drivers or customers' share of the investment; on nationwide average utilities typically pay ~50% of total cost.

[13] CPUC 93-09-078, *loc. cit.*, including CPUC correction for lower avoided costs; New York evaluation summary by Jim Gallagher, in press, August 1995.

frigeration, and lighting—were designed to use ~20% of the energy allowed by the strictest energy code in North America. Yet in a mature market, rather than a one-off experiment, the marginal construction cost of this design was calculated to be ~$1,800 *less* than normal, and the present-valued maintenance cost ~$1,600 *less* than normal. The last seven measures needed to eliminate the last one-third of the air-conditioning capacity had been previously screened out as not "cost-effective," meaning that they didn't save enough *energy* to pay for themselves; yet when also credited with their saved *capital* cost from eliminating the last ~$1,500 worth of air-conditioner and ductwork, they *were* cost-effective.

- Over a decade earlier, Rocky Mountain Institute had similarly shown reduced construction cost from eliminating the heating system in a climate going to –44°C: the marginal cost of superinsulation, superwindows, and ventilation heat recovery was less than the avoided capital cost of the furnace and ductwork.
- Both these cases illustrate how single expenditures can yield multiple benefits: energy savings, capital savings, and in some cases other values (*e.g.*, spectrally selective glazings improve radiant comfort, permitting a re-setting of the thermostats and thus saving still more energy). Even more kinds of quantifiable engineering-economic benefits are available: superwindows have ten main kinds, premium-efficiency motors 12, dimmable electronic ballasts 18. Yet standard engineering methodology wrongly counts *only one* (direct energy savings). When other benefits are also counted, such as avoiding capital costs by downsizing or eliminating mechanical equipment, it is quite common to find that *big energy savings can be cheaper than small energy savings.*[14] Because multiple benefits from single expenditures are quite common with good engineering, such a downward-dipping supply curve of the efficiency resource, "tunneling through the cost barrier," has now been observed[15] in big and small buildings, hot and cold climates, new and even retrofit buildings, motor and lighting systems, hot-water systems, computer design, and even car design.[16]
- Another way to make big savings cheaper than small ones is to do a retrofit when some other major improvement must be done anyhow, such as renewing a building's exterior skin or renovating its mechanical equipment or glazings because of aging or other needs such as displacing chlorofluorocarbons. The energy-saving retrofit can then be advantageously coordinated with the improvements that are needed anyhow.
- An example combining these two concepts—multiple benefits and optimal timing—is the recently described design of a retrofit for a large, 20-year-old curtainwall office building with failing glazings in a severe (Chicago) climate.[17] Replacement superwindows could insulate four times as well, admit six times as much daylight but 10% less unwanted solar heat, and at least double sound attenuation, yet cost scarcely more. Combined with deep daylighting and with efficient lighting systems and plug loads, the reglazing would reduce cooling loads by nearly fourfold. But the mechanical systems, being also 20 years old, needed renovation. Retrofitting them instead to nearly four times the original system efficiency would cost 2½ times more *per ton* but one-third less *in total* because of the almost fourfold decrease in tonnage. Respending that saved renovation cost on the superwindows and the lighting retrofit would then yield a 75% predicted saving, with a simple payback ranging from –5 to +9 *months*.

8. *From equipment to applications and* then *equipment.* Most designers think of a lighting retrofit as modifying the existing lighting equipment: in the case of a tubular-fluorescent ceiling troffer, perhaps installing imaging specular reflectors, dimming electronic ballasts, T-8 tristimulus-phosphor lamps, and dimming and occupancy controls. This sensible package saves ~70–90% of lighting energy, yields unchanged illuminance with greatly improved quality and aesthetics, and has a technical cost that pays for itself (against 5¢/kWh electricity) in about 1½ years with, or up to 4 years without, credit for its saved maintenance and air-conditioning costs.[18]

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[14] The standard theoretical assumption that the supply curve of the efficiency resource is monotonic upwards is often empirically untrue even at a *component* level. Data collected by Evan Mills for Swedish refrigerators, by RMI for TVs, by the University of Lund for industrial pumps, and by E SOURCE for 5.1–20-ton rooftop chillers and for 1-, 10-, and 100-hp NEMA Type B 1800-rpm asynchronous motors shows *no* correlation between efficiency and price.

[15] A.B. Lovins, "If You Think Education Is Expensive, Try Ignorance," address to E SOURCE Corporate Energy Managers' Consortium, 6 June 1994 (RMI), and experimental results of PG&E's ACT^2 experiment.

[16] Technical publications of The Hypercar Center, Rocky Mountain Institute ('hypercar@rmi.org').

[17] A.B. Lovins, "The Super-Efficient Passive Building Frontier," *ASHRAE J.* 37(6):79–81 (June 1995).

[18] A.B. Lovins & R. Sardinsky, *The State of the Art: Lighting*, RMI/COMPETITEK, 1988, illustrated in Fickett *et al.*, *loc. cit. supra*, and broadly consistent with other analyses, *e.g.* M.A. Piette, F. Krause, & R. Verderber, *Technology Assessment, Energy-Efficient Commercial Lighting*, LBL-27032, Lawrence Berkeley Laboratory (Berkeley CA),

But it is *not* the right thing to do first; rather, it is only the sixth of seven steps (the seventh being improved training, maintenance, and management of the lighting system). The first five steps, often omitted, are:

- Improve the quality of the visual task.
- Improve the geometry (*e.g.*, source/task/eye relationship) and the cavity reflectance of the space.
- Reduce veiling and discomfort glare so as to improve lighting quality and contrast.
- Provide the right amount of the light on task for the task and viewer, with proper luminance ratios.
- Harvest passive (natural) lighting where feasible and cost-effective.

Similarly, many mechanical engineers called upon to improve the efficiency of cooling a large building will propose a more efficient and variable-speed chiller, variable-air-volume distribution with variable-frequency inverter drives for the supply fans, and the like. But while often valid, these improvements should be only the fifth step of seven in a logical cooling sequence. The previous four are:

- Expand the range of conditions in which people feel comfortable, by exploiting such variables as radiant comfort, turbulent air movement, and use of ventilative rather than insulating chairs.
- Reduce cooling loads by severalfold through better glazings, lights, plug loads, building-shell albedo, vegetative shading, surrounding microclimate, etc. In new buildings, architects can also exploit such important variables as siting, built form, orientation, massing, and shading.
- Exploit passive cooling—ventilative, radiative, and ground-coupling.[19]
- If needed, harness alternative cooling—evaporative, absorption, desiccant, and combinations of these.

Only after these first four steps should the designer make the refrigerative system more efficient (if it's still there), followed by improved controls and last perhaps by coolth storage if there's anything left to store. Yet most designers pursue these steps in reverse order and miss all the potential capital-cost savings.

Or yet again, if an engineer is trying to make a motor/pump system more efficient, the best place to start is by asking how much flow is required, and when, for an optimal process optimally controlled; then with how little friction that flow can be delivered through required pipes and valves (laying out the pipes first, then the equipment); then by seeking the optimal size and performance of the pump, then the drivetrain, then the motor, then the inverter, then the electricals. Energy saved at each step will avoid the compounding losses of delivering energy *to* that step in the pumping process, multiplying any energy savings achieved at the downstream (flow) end. It is therefore not unusual for a unit of saved flow to save *nine* units of fuel at the power station. Even more importantly, avoiding compounding losses often makes the expensive upstream components (pump through electricals) severalfold *smaller* and cheaper. Skilled downstream-to-upstream redesign of pumping systems in big buildings can cut pumping energy by ~90%, reduce equipment sizing severalfold, reduce whole-system capital cost, and improve reliability, controllability, and performance.[20] But capturing these energy and capital cost savings requires whole-system engineering with meticulous attention to detail, and as noted below, that is not what most clients today expect, request, reward, or receive.

9. *From engineered delivery to market-making.* Utilities in the 1970s tended to decide what efficiency improvements their customers should have, then deliver them directly ("We will wrap your water heater"). Utilities in the 1980s tended to let customers choose and buy the equipment, but still wanted to decide themselves what choices would be rewarded ("We will rebate each electronic ballast"). The best utilities in the 1990s build on the considerable achievements and flexibility of classical implementation programs: targeted and general information, rebates throughout the value chain (designer, manufacturer, wholesaler, retailer, installer) and for scrappage, rewards for beating minimum standards, concessionary loans, gifts, "golden carrot" contests to bring innovations to market sooner, equipment leasing, and third-party investments such as performance contracts. However, although these techniques can maximize participation and savings per participant, they cannot also maximize competition in who saves and how, so as to keep driving costs down and quality up. To

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1989, and with field experience. Most retrofitters omit important elements of the package, fail to take proper credit for some of the measured savings mechanisms, and hence save less but at a higher unit cost than they should.

[19] These are surprisingly effective in most climates: one can maintain ASHRAE comfort in summer in Miami with nothing more than a roof pond and a ceiling fan. J. Cook, *Passive Cooling*, MIT Press (Cambridge MA), 1989.

[20] Lee Eng Lock, Technical Director, Supersymmetry Services, Singapore, personal communications, 1989–95.

achieve this requires not simply marketing negawatts but also making markets *in* negawatts: making saved electricity into a fungible commodity subject to competitive bidding, arbitrage, secondary markets, derivative instruments, and the other mechanisms that work for other commodities. To this end, utilities have developed bidding processes ranging from industrial modernization grants (to those customers who offer to save the most electricity per dollar of grant) to all-source bidding; ways to resell and wheel savings between customers, utilities, and even nations; ways to repurchase from customers both reduced demand and reduced uncertainty in demand—both resources that merit markets in which to express their value; ways for electric or gas utilities to sell electric efficiency in each others' territories; and performance-linked hookup fees or "feebates" (when you connect to the grid, you pay a fee or get a rebate; which and how big depends on how efficient your usage is; and the fees pay for the rebates—a system that is attractively revenue-neutral, yet unlike building standards, elicits continuous improvement).[21] Spot, futures, and options markets in both watts and negawatts cannot be far behind, with all the arbitrage opportunities they imply. The most attractive directions for utilities' efficiency programs clearly lie in these market-transformation directions...bringing us to the next opportunity.

10. *From promoting hardware to correcting market failures.* Making buildings far more efficient requires seeking "trimtabs" to correct perverse incentives: *e.g.*, rewarding architects and engineers for what they *save*, not for what they spend.[22] But it also means fundamental reforms in the dis-integrated design process[23], and replacing obsolete, fragmented rules-of-thumb with true whole-system optimization.[24] For example, pipes are normally sized using rules-of-thumb that count avoided pumping energy but not avoided *sizing* and hence capital cost of the pump-system components (pump, drivetrain, motor, inverter, electricals); yet those are by far the costliest parts. Similarly, most large U.S. buildings lose ~4–8% of their metered electricity before it reaches the load terminals—because wire size is specified by the low-bid electrician who is told to meet code, and the National Electrical Code's wire-size table is meant to prevent fires, not to save money; it's implicitly optimized at an order of magnitude below typical electricity prices. The economic optimum is to make the wire at least twice as fat, therefore with one-fourth the losses of the size normally installed.[25] Such egregious design errors are not unusual in the rules-of-thumb now used to size not only wires and pipes but also pumps, fans, motors, insulation, heat exchangers, and almost every other technical element that now wastes electricity.

11. *From engineering/economic models to the often different insights of energy anthropology.* Compelling evidence from this new discipline shows that both the engineering and the economic models of human behavior used to design efficiency programs and apparatus are often not only incomplete but also seriously misleading. For example[26], most people in hot apartments, if given free air conditioners and free electricity, will *not*, as economic theory predicts, turn on the air conditioner when they feel hot and set its thermostat at a temperature at which they feel comfortable. Only about 25–35% of American subjects behave in that way. Most, if they run the air conditioner at all, will instead do so in a way only very peripherally related to comfort, but rather depending mainly on household schedules, folk theories about how air conditioners work, general strategies for dealing with machines, complex belief systems about health and physiology, noise aversion, and (conversely) wanting white noise to mask outside sounds that might wake the baby. To be sure, both the engineering and the economic models of energy-using behavior are useful. But as any marketer knows, not giving at least equal weight to the complexities of human behavior wastes opportunities and risks unpleasant surprises.

12. *From marginal economics to qualitative superiority.* For decades if not centuries, engineering economics has balanced the cost of an efficiency improvement against the present value of the *energy* it will save. The resulting mindset of diminishing returns is not only incorrect in engineering terms (please see #7 above); it also misses an even more important point, namely that energy savings may be not the main economic motive for saving energy, but a rather minor byproduct of achieving a far more valuable result: not environmental or

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[21] A.B. Lovins & M. Shepard, "Financing Electric End-Use Efficiency" and "Customer Behavior and Information Programs," RMI/COMPETITEK, 1989.

[22] *Energy-Efficient Buildings: Institutional Barriers and Opportunities, op. cit. supra.*

[23] *Id.; cf.* W.D. Browning, "NMB Bank Headquarters," *Urban Land*, pp. 23–25 (June 1992); D.L. Barnett & W.D. Browning, *A Primer on Sustainable Building*, RMI, 1995.

[24] "If You Think Education Is Expensive, Try Ignorance," *op. cit. supra.*

[25] Ned Brush has calculated a socially optimized wire-size table for the Copper Development Association (NY).

[26] A.B. Lovins, *Air Conditioning Comfort: Cultural and Behavioral Aspects*, E SOURCE (Boulder CO), SIP-1, 1992, citing chiefly research led by Willett Kempton and Loren Lutzenhiser.

other social externalities in the usual sense, but some extremely valuable *joint outputs* of the energy-saving action, such as improved quality and productivity. For example, a typical American office pays about 100 times as much for people as for energy. A 1% increase in labor productivity would therefore have the same bottom-line value as eliminating the entire energy bill. Yet eight compelling case-studies from offices, shops, and factories have recently shown labor-productivity gains of *6–16%* from well-designed energy-saving improvements that also happen to improve visual, thermal, or acoustic comfort.[27] Such data had not previously been collected because of the pervasive mythology of the Hawthorne effect, which supposedly showed that only management methods, not working conditions, affect productivity. (In fact, the Hawthorne experiment never showed that, and it wasn't statistically valid anyhow, but its mythology lingers.) There is now, in short, good reason to believe that many important kinds of electricity savings are about an order of magnitude more valuable than would have been concluded from their energy value alone. This in itself should propel a revolution in how negawatts are marketed. Saved energy costs may be the *least* important benefit.

Collectively, these transitions imply a broad and important slate of new opportunities to make negawatts even cheaper, more numerous, and more valuable than their strongest advocates might have supposed a year or two ago. For completeness, the resulting agenda is summarized next. It omits such obvious, helpful, and insufficient solutions as proper pricing.[28]

Eight Ways To Make Negawatts Work Better and Cost Less

A. More bang per buck: better technological content. This means more modern and better selected technologies, bundled into integrated packages and counting all relevant benefits (see #7 and #12 above), and done in the right sequence—application before equipment (#8 above).

B. More bang per buck: better program designs. Some rebates should be restructured to go further upstream so as to capture the leverage of manufacturer/wholesaler/retailer markups. Inefficient old equipment should be scrapped so it doesn't reënter secondary markets and have to be retrofitted out again. Free drivers should be maximized via effective outreach so more people follow paid participants' good example without payment (and evaluation methods should be modified so this valuable spinoff is rewarded, not penalized). Free riders may also be worth maximizing to transform markets, as B.C. Hydro did to switch its big-motor market from standard- to premium-efficiency models.[29] Program design should maximize competition and innovation (#9 above) and should slash transaction costs. Important, very inexpensive new opportunities beckon in often-neglected human-capital and organizational-process areas: operation and maintenance, commissioning, training, and education. Today's soft commercial leasing markets and the need to displace CFCs offer exceptional new marketing opportunities for well optimized efficiency packages—especially if such attributes as productivity, waste minimization, quality, amenity, productivity, and pollution prevention are marketed at the same time.

C. Bootstrap from savings elsewhere in the utility. A package of ~35 improvements to typical industrial motor systems can save ~50% of their metered energy (per unit of input torque to the driven machine) with a simple payback under ~16 months at a 5¢/kWh tariff.[30] The saving is so cheap because purchasing seven kinds of improvements typically yields a further ~28 as free byproducts. Savings further downstream, in and beyond the driven machine (such as a pump or fan), are often even larger and cheaper, and should be done first so as to capture the compounding savings in equipment sizing and cost upstream (#8 above). But such opportunities are not confined to *customers*: they should be demonstrated first by *utilities* in their own facilities, from HVAC to power-plant auxiliary drives. EPRI case-study retrofits, for example, showed many years ago the dramatic energy and cost savings available from variable-speed drive of induced draft fans and condenser feedwater pumps. Yet astonishingly few utilities have followed that example and improved their thermal power stations' heat rate, load-following ability, and availability. Money so saved could bootstrap even more savings for both utilities' own operations and their customers'.

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[27] J.J. Romm & W.D. Browning, *Greening the Building and the Bottom Line*, RMI, 1994, Publication #D94-27.

[28] R. Cavanagh, "Energy-Efficiency Solutions: What Commodity Prices Can't Deliver," *Ann. Rev. En. Envt.* 20:519–525 (1995), in press.

[29] T. Flanigan & A. Fleming, "BC Hydro Flips a Market," *Publ. Utils. Fortn.*, pp. 20–22 & 34 (1 August 1993).

[30] A.B. Lovins *et al.*, *The State of the Art: Drivepower*, RMI/COMPETITEK 1989. EPRI reached a similar conclusion by a somewhat different route a year later (Fickett *et al.*, *op. cit. supra*).

Similarly, "precision-guided programs" that target customer efficiency in the specific areas and end-uses that can best defer or avoid costly expansions of grid (especially distribution) capacity can save extraordinary capital sums that can again be reinvested in customer efficiency without increasing pressure on electricity prices. At Ontario Hydro, the first three case-studies of this approach cut capital intensity by up to 90% and saved ~US$0.5 billion net.[31]

Further opportunities include retrofits of utilities' office and other non-power facilities, thus reducing General and Administrative costs and perhaps improving labor productivity (#12 above). In some cases, too, savings by utilities *or* their customers may enable utilities to free up and monetize emission rights under emission trading systems.

D. Get participating customers to pay more. This furrow has been thoroughly if not excessively plowed. Salient examples include Central Maine Power's industrial modernization grants; shared-savings programs such as PacifiCorp's FinAnswer, hybrids such as Southern California Edison's ENvest, the Land and Water Fund's bonus concept, and Wisconsin Electric Power Company's end-use pricing; rebate/loan choices (Burlington Electric, Wisconsin Power & Light); and leasing (Alberta Power). In general, performance has fallen short of expectations, but the concept merits further exploration and improvement, so long as it does not unduly shrink participation rates by creaming off only those few customers with the lowest implicit discount rates—the business opportunity, after all, is arbitrage on the spread between the utility's and the customer's discount rate—or imposing entry fees that suppress participation to an extent that sacrifices important system benefits.

E. Get third parties to pay more. Energy service companies are familiar, and even dominate a few sectors such as the provision of commercial buildings' heating in France. "Virtual ESCos" could also wheel saved power between customers and utilities. Revenue-neutral feebates (#9 above) pay for savings from charges on those whose inefficient choices increase system cost. Multi-resource consortia can pay for electric savings from collateral benefits such as saving—in the case of, say, a superefficient washing machine—most of its water and sewage flows, chemical discharges, and landfill space (if it's more durable, remanufacturable, or recyclable), while providing local manufacturing jobs and capturing their multiplier. Marketing partners may be willing to pay for access to a utility's customers for their own purposes, or to provide to those customers other valuable concessions that help to market the efficiency program.[32] And advanced energy retrofits' potential to turn around distressed commercial properties may be a welcome lifeline to financial institutions saddled with nonperforming assets.

F. Pay for efficiency from new profit centers which it creates. For example, part of an intelligent response to real-time pricing[33] could be the installation of highly capable near-real-time meters, perhaps like the Metricom/Landis & Gyr type that uses packet-switching radio. Such a network is amply cost-justified by its internal benefits to the utility, but also happens to come with extra bandwidth that can be sold or leased to telecommunications firms. Moreover, some of the benefits of such metering may be quite surprising. Of course the utility expects to pay for the meters and radios through savings on meter-reading, remote connect/disconnect, emergency response, load management, and instant resolution of customer complaints about meter accuracy. But who would have guessed that SCE's 3,000-meter NetComm experiment would find that one-fifth of the test homes were miswired, with no functional ground or with ground and neutral interchanged—or that just having retail-meter-level real-time voltage information systemwide could improve substation-level voltage control enough to save 1 TW-h/y of generation?

G. Incentivize utility staff. Just as utilities should be rewarded for cutting customers' bills, not for selling more energy, so should their staff members who are responsible for helping customers to use electricity more productively.

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[31] John Fox (General Manager of Hydro's downstream half), personal communications, 1994–95; N. Lenssen is also preparing a 1995 E SOURCE Strategic Issues Paper on this experience. When Mr. Fox previously ran PG&E's efficiency programs, its first effort at precision-guided programs, the Delta Project, largely failed for site-specific reasons. But at Hydro, Mr. Fox later proved the concept sound and successful.

[32] *E.g.*, when Janet Benjamin was a marketing consultant to B.C. Hydro's PowerSmart program, she found that a major bank, seeking new mortgage relationships, was willing to reduce its construction- and mortgage-loan interest rates for PowerSmart customers, while a major lighting-equipment manufacturer would equip for free one house for every ten equipped with its PowerSmart-compliant products.

[33] J. Newcomb & W. Byrne, *Real-Time Pricing and Electric Utility Industry Restructuring: Is the Future "Out of Control?"*, E SOURCE (Boulder CO), SIP-5, April 1995.

Incentives work. At one utility that started paying a $1 bounty for every kilowatt saved, the volume of savings achieved (verified by *ex post* audit) went up and their cost went down—both by an order of magnitude.

H. Rethink the conceptual foundations of saving electricity. Harnessing the new social-science insights emerging from energy anthropology (#11 above) is an important new tool. Potentially even more powerful is the detailed process analysis of how market failures happen (*e.g.*, the buildings example mentioned in #1,10 above). More than one alert utility, on studying that analysis of perverse incentives, has decided to redesign its commercial-sector efficiency efforts from scratch: paying several years' worth of energy savings to the design team, they felt, could displace far larger rebates for using efficient equipment. After all, the efficient equipment usually cost less[34], but either the designers didn't know how to specify and obtain it or, if they did, they knew that their fees (based on the *cost* of equipment specified) would fall while their effort went up, yielding a negative profit on the engagement. If that perverse incentive in design professionals' compensation is corrected, then it should no longer be necessary, in general, to rebate the equipment they specify.

Collectively, these eight classes of approaches provide an extremely powerful menu of ways to get far bigger and cheaper savings than any utility now does, and to do so at lower cost and hence with less potential for upward short-term pressure on electricity prices.[35] The resulting better, cheaper, and faster gains in the productivity of using electricity will benefit everyone, under *any* evolution of the utility system. In fact, this point is so fundamental that it bears emphasis in concluding remarks about the wider context of this issue of *Energy Policy.*

Retail Wheeling: Big Noise on Stairs, Nobody Come Down

It has lately become fashionable to premise discussions of the future role of electric efficiency on the notion that a century of utility structure and regulation, especially in the United States, is being rapidly swept away by a surging torrent of retail wheeling (the ability of any customer to buy electricity from any supplier), usually considered synonymous with "deregulation."[36] While, as will be seen, I agree that the utility industry is in for even more wrenching change than advocates of retail wheeling propose, I think the premise that this change will be manifested as retail wheeling, let alone that retail wheeling is synonymous with deregulation[37], is false to a degree that its advocates will soon find embarrassing—an artifact of loose language and sloppy thinking.

The trade, professional, and public press have all reported, even in the most respected newspapers of record, that California has ordered retail wheeling and that others of the United States are rapidly following suit. That is rubbish. California's five-member PUC did unexpectedly publish in April 1994 a staff proposal for rapid adoption of

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[34] Mainly because it was smaller and simpler after the load reductions, although its *unit* cost, *e.g.*, per ton of cooling capacity, might be higher.

[35] Acknowledging this concern does not, however, constitute acceptance of the Rate Impact Measure test for efficiency investments—a test whose misuse to screen out measures or programs *guarantees* societal misallocations. Some utilities' pleas for the RIM test to ensure equity between participants and nonparticipants might be more convincing if (a) those same utilities had cared about equity when building needless power plants and grid assets that forced electricity prices to the levels that now create political pressures (costly capacity and overcapacity created rate pressure that dwarf those of efficiency programs, and every supply-side investment flunks the "no-losers" test that RIM advocates wish to apply asymmetrically to demand-side investments only); (b) the equity effects cited rose above the clearly immaterial (E. Hirst & S. Hadley, "Rate Impacts of Electric Utility DSM Programs," ORNL/CON-402, 1994), and A.B. Lovins, "Saving Electricity Doesn't Have to Mean Raising Rates," RMI Publication #U88-16, 1988); and (c) *all* customers didn't get vastly larger system benefits from the least-cost investment.

[36] This is especially odd because it is widely perceived to have been triggered by Britain's, Norway's, and New Zealand's privatization and "deregulation," followed by others such as Chile's. Those situations are profoundly different from that of the U.S., and all, though interesting, are problematical in different ways. For example, Britain, far from deregulating, established a Regulator for the first time, and the need for his intervention has steadily grown ever since. However, the enabling statute was fundamentally flawed, so the wholesale marginal price is effectively set not competitively but by a duopoly, and the regional distribution companies are explicitly rewarded for selling more electrons, not for cutting customers' bills. No halfway reform can mend these key flaws.

[37] Let alone "retail competition," which we have had for a long time: any customer has always been free to fuel-switch, buy end-use efficiency, or do onsite generation, all without the utility's knowledge or consent. Thus utilities' electrons have *always* had to compete at the retail level with other ways of providing the service.

retail wheeling, but in a proposed order on 24 May 1995, on riper consideration, the CPUC *rejected* that concept by a 3–1 vote. Rather, the three majority Commissioners proposed to adopt a largely sensible framework I had dubbed "virtual retail wheeling"[38] because it yields all the putative economic-efficiency benefits of retail wheeling with none of its difficulties. In essence, it is William Hogan's proposal for "Efficient Direct Access," nicely refined through the efforts of advisors and stakeholders convened mainly by San Diego Gas & Electric Company, and now accepted by all three California investor-owned utilities. It has three main elements:

- a new, independently operated regional market-maker in wholesale electricity ("Poolco") would clear that market half-hourly, take no positions on its own account, process settlements, and discover real-time spot prices for electricity;
- retail customers would buy electricity exclusively from their normal local utility at prices whose fixed component came from traditional ratemaking and whose variable component equalled (or added a fixed amount to) that spot price; and
- utilities would no longer be responsible for assembling, aggregating, and maintaining a portfolio of resources, but rather would simply buy and provide spot-priced electricity (giving no specially favorable access to their own generation) bundled with whatever other services or attributes their customers desired.

Under this system, any longer-term portfolio attributes desired would be assembled *by customers* through their unregulated, unreported private acquisition of Contracts for Differences or other hedges, options, insurance, etc., motivated solely by deep forward markets with long-term prices (unless augmented by regulators' or legislator' mandates, which could be expressed as *e.g.* diversification quotas or explicit subsidies but implemented by competitive bidding). There would be no actual financial transaction or notional physical transaction between retail customers and any electricity suppliers other than their local utility, so the paralyzing jurisdictional disputes, legal rewriting, and institutional transformations required by retail wheeling would not be necessary. Most importantly, utilities would continue to be rewarded by appropriate regulatory incentives for acquiring the cheapest resources, whether supply- or demand-side, and for flowing those resources' benefits through to customers. Appropriate fixed costs such as farsighted R&D, grid costs, and recovery of the utility's sunk generating costs would occur through the fixed-cost component of the tariff just as now. So could the costs of cost-effective demand-side investments. (Alternatively, any or all of these costs could be charged per kWh, not per customer.) The CPUC explicitly stated its desire to retain its decoupling of utility profits from sales volumes, albeit with modifications not yet stated, and for the time being to retain current efficiency and load-management programs and their traditional cost recovery. The bedrock principle of performance-based regulation that rewards lower retail *bills*, not ¢/kWh, appears to be intact.[39]

What of other states? Before California rejected its own retail-wheeling proposal, quite a few states had already rejected similar or worse ones, often deterred by the prospect of putting their prize customers "in play" to be picked off by neighboring states' utilities without reciprocal access to theirs.[40] (As a New Mexico legislator remarked, "If you're the only kid on the block who says, 'Come play with my toys,' everyone will come play with your toys.") Contemplating this risk and even more daunting legal ones, only two states did anything[41]: Nevada offered retail wheeling to a particular steel rolling mill if it were built there (but so far it hasn't materialized); and Michigan authorized a limited-term, new-capacity-only, ~1%-scale experiment that was promptly taken to court by both Detroit Edison and the state Attorney-General.

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[38] A.B. Lovins, invited comments of 17 August 1994 to CPUC President Fessler (see also comments of 22 May 1994, reprinted in *El. J.* 7(6):67–80 [July-August 1994]), RMI Publication #U94-18.

[39] The majority also expressed its willingness to consider retail wheeling in four years if all its key problems could be solved, but displayed little optimism they could be nor belief they would need to be. The main conceptual problem remaining in the proposed order is the distortion it would introduce by not fully exposing nuclear generation to the discipline of pool dispatch. There seems no economic rationale for this exception.

[40] An astute 1994 California Energy Commission legal opinion showed, and the weight of authority concurs, that requiring such reciprocity would founder on the U.S. Constitution's Commerce Clause.

[41] At this writing, industrialist/environmentalist consensus proposals are pending in Massachusetts and Rhode Island but are a long way both from regulatory approval and from bearing much resemblance to what is normally described as retail wheeling. Emphasizing end-use efficiency and load management, rewards for cutting customers' bills, renewable energy, and other standard fare of environmentalist reforms, they would simply allow major industrial customers to try to beat the utility in the spot market, but not to escape stranded-asset costs.

Those lawsuits, wending their leisurely way toward the Supreme Court, soon became largely moot with two 29 March 1995 proposed orders by the Federal Energy Regulatory Commission. This "Mega-NOPR," which I interpret as quite discouraging to retail wheeling, states in detail how FERC intends to create the vibrant wholesale market required by the National Energy Policy Act 1992; warns that customers leaving the grid to shop around will *not* thereby escape paying for the assets they strand, but will be liable to pay for them anyway via wires charges (as the California PUC had also proposed in its original retail-wheeling Blue Book); and says that any state authorizing retail wheeling will thereby simply be transferring its authority to FERC, which will then interpret the transaction as a wholesale one and assert full jurisdiction all the way to retail distribution. Some "deregulation."

Of these FERC conclusions, the most devastating to retail wheeling is the most basic—the elaboration of how to carry out the 1992 Congressional mandate for full wholesale competition—because *wholesale competition will capture essentially all of the same benefit that was claimed to justify or require retail wheeling*[42], and it can only be captured once. Capturing that benefit—buying electrons in bulk at competitively reduced prices—by keeping the competition where it's needed, at the wholesale level, is entirely consistent with *also* capturing the severalfold larger benefit of efficient end-use by retail customers; whereas retail wheeling, using any conceptual structure proposed so far, would gravely inhibit if not destroy that larger benefit. Obviously it is better to seek, reward, and obtain *both* benefits than to trade off one for the other. Wholesale competition *plus* state regulation that rewards utilities for cutting customers' bills will indeed capture both benefits. It will do everything the advocates of retail wheeling want—except shift their costs to other customers. Indeed, San Diego Gas & Electric has persuasively argued that it will even make bilateral contracts unnecessary: SDG&E's version of the Poolco proposal provides "virtual bilaterals" with no actual bilateral relationships, all the same benefits, and none of the complications.

While many details, some of them quite important, remain to be worked out in both the California and the FERC proposals, the only three real proposals yet acted upon—a revolution offered and then rejected by California, a single-plant bribe offered (so far in vain) by Nevada, and a minor experiment authorized by Michigan but vanished into the litigative vortex[43]—hardly constitute the tidal wave of retail wheeling announced in the press. Where is that much-ballyhooed deregulatory tsunami? Only in the fertile imaginations of its advocates. And who are they? Largely a curious coalition of large industries[44] eager to grab the cheapest power at everyone else's expense, free-market ideologues with limited knowedge of utility reality and history, anti-environmentalists who think retail wheeling is a neat way of avoiding environmental accountability or expenditures and of killing demand-side programs they find ideologically distasteful, and consultants who see chaos as a profit opportunity and are not averse to helping create more. Though this unholy alliance has been surprisingly effective for a time in wrapping its notions in the superficially attractive language of "choice" and "competition," I think common sense, helped by Professor Hogan's and other independent analysts' incisive reasoning, is starting to reassert itself among regulators.

But meanwhile, many utility managers, not content to see Wall Street chop off their legs as analysts foresaw eventual confiscation of shareholder assets on a massive scale and hence wiped scores of billions of dollars off utility equity values, have started to chop off their own arms too—by preëmptively slashing their demand-side programs as a "customer-service frill" that will have no place in the cold, harsh world of competition. This panicky reaction, which has already destroyed or degraded many important efficiency capabilities (and done the same or worse to

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[42] In theory, some modest marginal benefit of retail wheeling might remain if utilities failed to offer to customers as full a menu of unbundled and rebundled service options as independent providers wished to offer and customers wished to buy. In practice, however, it is hard to see how this potential Pareto improvement lost by using the utility as a second-best and perhaps not fully transparent service provider could be very substantial, especially since the utility would remain the sole provider only of *electrons*: any providers of unbundled financial, efficiency, or other services who felt inadequately served by the utility as intermediary could still sell services directly to customers.

[43] However, mid-1995 rulings by the Michigan PUC, clearly driven by political direction rather than by the record, essentially dismantled Michigan utilities' strongly demanded and highly cost-effective efficiency programs. (In 1994, for example, Consumers Power's programs were oversubscribed by 7:1 and save at an average cost of ~1.5¢/kWh.) Michigan industries' and utilities' resultant handicaps in the marketplace will follow in due course.

[44] Chiefly ELCON, whose members use 4% of U.S. electricity. However, discussions with many of those firms leaves me convinced—as are they when we discuss the technical details—that they all have vast untapped opportunities to increase their electric productivity at far below short-run marginal supply costs. While it is natural for a profit-seeking organization to seek to shift its costs to others with less market or political power, those firms' lack of zeal in pursuing their own demand-side opportunities casts doubt on their seriousness about cutting costs.

nationally vital R&D strengths[45]), is unsound for two main reasons: it misreads the lessons of competition in other industries, and it gets exactly backwards the role of efficiency services in a competitive environment.

My colleague Jim Newcomb has compellingly presented elsewhere[46] an insightful view of the restructuring of other industries undergoing competitive restructuring and deregulation. In every case—airlines, oil, gas, telecommunications, trucking, etc.—market actors who expected the business to turn into a purely price-driven commodity play did poorly. The firms that survived and prospered were those that appreciated early that any retail business is quintessentially a *service* business. Retail customers generally want not only affordable commodities but also a bundle of other services and attributes. Gas customers, for example, want not only cheap methane molecules but also inventory management, storage, price hedging, etc. Telephone customers want a variety of services now proliferating in immense variety, not just low cents-per-minute. Airline passengers tend to want services too: courtesy, reserved seats, baggage interlining, food, etc., not just low cents-per-seat-mile.[47] Thus utilities that try to carry the cheap-electrons-only mentality from wholesale to retail levels will do so at their peril.

Indeed, those frozen-in-the-headlights utility executives' assumptions about the inevitability of retail wheeling would suggest precisely the *opposite* of their conclusions about their efficiency programs. In a competitive world in which all retail distribution entities are buying bulk electrons at competitively leveled prices, it will be very difficult to distinguish one's service from others' except by offering the one really big advantage available: bundling electrons with their far more productive end-use, so as to deliver dramatically lower bills and better end-use services. For this reason, if retail wheeling *were* likely, a strong portfolio of efficiency services would become *more* rather than less important as a core element of utilities' competitive strategy: an unbeatable way to differentiate service, boost value, build customer loyalty and success (hence competitiveness, size, and demand growth), retain wavering customers, enhance public image, reduce present and future system costs and risks, cut rates *and* bills, and provide profitable service benefits to both customers and utilities. Jettisoning this capability in a competitive environment is an irrational act of unilateral disarmament.

It remains to be seen how rapidly utility managers come to understand the new world of wholesale competition, continuing regulatory turbulence, and ever more dramatic technical progress in and market demand for the attributes that advanced electric end-use efficiency alone can provide. Powerful market forces are at work, some largely unseen: Rocky Mountain Institute's real-estate practice, for example, is finding such superior financial performance from highly efficient buildings that utilities which fail to offer an attractive efficiency partnership may find themselves increasingly irrelevant to some of their biggest customers.

Why, then, did I say at the start of this concluding section that I thought the most radical changes in the utility industry were yet to come? Because the generals are, as usual, fighting the previous war. About the time we get really good at wholesale competition, we probably won't need it, because cheap proton-exchange-membrane (PEM) fuel cells, photovoltaics, and other decentralized generators, augmented by efficient end-use and by decentralized electric storage, will have put virtually all of today's central thermal stations out of business. There are three main reasons I now think this is plausible over the next couple of decades:

1. "Distributed benefits" omitted from traditional comparisons between centralized sources collectively raise distributed resources' economic value by about half to one order of magnitude—enough to make even such relatively costly options as photovoltaics cost-effective *now* in many applications.[48] The Hoganesque restructuring described above will increasingly give these benefits a voice in the market. For example, resources near the

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[45] TECC Group (Littleton CO 80162-1992), *U.S. Electric IOU Research, Development, and Demonstration Expense Trends, 1990–94* (August 1995), found a $67.6 million or 9.9% drop between 1993 and 1994, compared with average increases of 4.5%/y during 1990–93. Worse yet, the best people, tired of budget fights, often left first.

[46] *The Future of Energy Efficiency Services in a Competitive Environment*, E SOURCE, SIP-4, 1994.

[47] It now appears from *Wall Street Journal* analyses that Southwest Airlines' initial advantage arose far less from its spartan flights than from its hubless structure, which enabled it to utilize its capital assets far more efficiently. Moreover, U.S. airlines' baroquely complex and daily changing fare structures so adroitly make customers (as an Ohio PUC member remarked) "an offer they can't understand" that their elegant price signals are quite opaque.

[48] A.B. Lovins & D. Yoon, "Renewables in Integrated Energy Systems," PictureTel address to ANZSES (Perth, W.A.), 3 December 1993, RMI Publication #E94-12, to be expanded in A.B. Lovins & A. Lehmann's forthcoming 1995 RMI technical publication.

load center—or *at* it, by definition, in the case of demand-side resources—will start to get due credit, via an appropriate locational and temporal rent, for their "grid Dristan" (decongestant) effects.[49] Peak-coincident resources, like photovoltaics (and often windpower) in summer-peaking areas, will get due rewards. Even more importantly, renewable sources will gain value as constant-*price* resources, and may even be properly evaluated at *risk-adjusted* discount rates reflecting their lack of future fuel-price or carbon risk.

2. Cost-effective onsite storage devices using carbon-fiber superflywheels[50] are widely expected to enter the market around late 1995 for power conditioning and uninterruptible power supplies, and about a year later for vehicular use. While their specific energy is expected to be comparable to that of good batteries (~35–100 W-h/kg), their specific *power* can easily be two orders of magnitude higher. Their demonstrated in-out cycle efficiency is at least 96%, their lifetime should be many decades, their coastdown time is months, and their cost is potentially quite modest. Such devices, probably soon supplemented by even higher-specific-power ultracapacitors, not only augment load management and end-use efficiency as potent responses to real-time pricing, which will therefore become far less important as the peaks disappear, but will also greatly facilitate the transition to intermittent renewable sources, making them "firm," dispatchable, and hence far more valuable.

3. Technological progress with local generation is not only extraordinarily rapid and encouraging of late, yielding net electricity costs well below 2¢/kWh[51]; it has also gained a new driving force, namely superefficient cars and other hybrid-electric vehicles[52] that obtain the benefits of electric propulsion without the disadvantages of onboard batteries. Ultralight, ultra-slippery "hypercars" require ~3–5-fold less peak power than conventional cars, and obtain only a modest fraction of that peak power from the onboard fuel-to-electricity conversion device, such as a small engine, gas turbine, or fuel cell. They can therefore adopt PEM fuel cells for that role far earlier in their development cycle than conventional cars could, because the ~5–10-fold smaller fuel cell will be correspondingly less sensitive to its cost, mass, or volume per kW. Moreover, since the hypercar burns only ~10% the usual amount of fuel, it can use a tenfold costlier fuel—probably more than, say, solar hydrogen compressed into cylinders would cost—without raising its fuel cost per km driven. Thus not only compressed natural gas with a small onboard reformer but also ~200-bar hydrogen gas[53] seem plausible as surprisingly early automotive fuels. Even hydrogen electrolyzed and compressed using offpeak retail electricity can beat taxed retail gasoline at U.S. prices—cheaper than bottled water—because of the remarkable fuel-to-electricity conversion efficiency of proven PEM technology: ~65% with hydrogen, or the upper 50s of percent with methane or ~55% with methanol, all about four times the ~15% average efficiency of a typical gasoline-powered automotive driveline. Mid-1995 evaluations of PEM fuel cells show[54] that established technology can almost certainly be mass-produced at costs below $250/kW, while the best experimental technology can probably beat $50/kW. Even with a reformer added (now as low as another ~$50/kW), such prices and efficiencies, plus the opportunity of onsite use of the waste heat, will clearly beat grid electricity almost anywhere natural gas is available, generating at ~1–2¢/kWh—less a broadly comparable credit for the ~80°C waste heat.

   The fuel-cell production volumes necessary to displace central power stations may well come first from cars, but it could happen the other way around. Which happens first is almost irrelevant: the key point is that of these two potentially enormous markets, both are likely to happen surprisingly soon, and once either of them does happen, the other will not be far behind. Much the same is true of the way fixed-site power-conditioning and -storage markets for superflywheels and ultracapacitors will bring down costs for parallel development in electrically propelled vehicles, and vice versa. Naturally, all these devices will have smart controls responsive

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[49] A.B. Lovins, comments of 17 August 1994 to CPUC, at pp. 3–6; to FERC, 24 July 1994 (urging symmetrical treatment for demand-side resources); and in EPRI, *DR Connection*, pp. 2–3, November 1994.

[50] W. Howe, "Protecting Facilities from Power Outages: Flywheel Technology Enters the Competition in an Emerging Market," E SOURCE (Boulder CO), TU-95-2, April 1995.

[51] T. Casten, remarks to Energy Committee of the Aspen Institute for Humanistic Studies, 12 June 1994, Trigen (White Plains NY), reporting net system efficiencies >90% and net electricity costs (after credit for industrial use of the waste heat) around 0.5–2¢/kWh from "trigeneration" with off-the-shelf MW-range gas turbines equipped with refiring and a waste-heat boiler. Many large industries have thermal loads of the required several-MW size.

[52] RMI Hypercar Center publications, *op. cit. supra*; these span the full range of technical content and depth.

[53] In a filament-wound carbon-fiber tank lined with a metallized polyester film; metal tanks are too heavy but do not appear necessary for excellent safety characteristics.

[54] *E.g.*, by Jeff Bentley of Arthur D. Little, Inc., Cambridge MA 02140-2390.

to the real-time price signals that will permeate the grid. Thus the beer-keg-sized household storage superflywheel will act as a house-scale power broker, buying and selling appropriately to maximize financial return.

PEM-fuel-cell cars could even make possible an option not practical with today's cars because internal-combustion engines are insufficiently durable: plugging the car, which is parked ~96% of the time, into the gas and electric grids as a dispersed *generator*—like a battery-electric car inside-out—with zero marginal capital cost and ~20 kW_e of highly reliable capacity. This is considerably more than the peak load of even an inefficient house. If even a modest fraction of car-owners did this, it could transform the utility business, because a full U.S. hypercar fleet, not counting heavier hypervehicles, could represent ~3 TW of generating capacity, or four times the total capacity of all grid-connected generators today, and the fuel cells are extremely long-lived. Thus utilities expecting to sell electricity to battery cars might find themselves buying it instead.[55]

In short, the prospect is now strong that some variety of new technologies, reinforced by the greater flexibility and diversity of the market actors becoming engaged in power markets at all levels, will realize Carl Weinberg's vision[56] of the "distributed utility" far earlier than anyone might have thought as recently as, say, 1994. The better the technology gets and the more rigorously competition hones our engineering economics, the faster the power plants (and new local storage devices with surprising capabilities) will shift to our roofs, basements, backyards, and driveways. The more distributed generation and storage resources disintermediate the distribution utility—which now moves across the meter and even *eliminates* the meter—the more irrelevant will become the otherwise historically observed tendency[46] for dis-integrated utility functions (genco, transco, disco) to seek vertical re-integration.

What is a "utility" that engineers, procures, leases, installs, and operates onsite resources which need no grid connection, or which optionally use it merely as a convenient local means of profitable temporal exchange? It is not a generator or distributor in the usual sense; it is purely an energy service company that provides light, comfort, and other end-use services, or the means to achieve them, right at your premises. Logically, its engineering and financing will intimately integrate end-use efficiency with the onsite supply, because that will yield the best buy. The elaborate arena just constructed for bidding bulk power sources will get bypassed by resources already *at* the users' premises and requiring no generation, aggregation, bidding, or distribution. Soon that shiny new arena could stand abandoned and empty, populated only by the ghosts of economic theorists long dead—blindsided, not for the first time, by the autonomous onrush of technologies they scarcely understood. This will not happen overnight, and the transition provides an impermanent "window" probably just long enough to pay off existing generating and grid investments before both they and the means of charging for them (as today's customers are steadily paying) become irreversibly bypassed. Happily, the transition seems likely to be long enough to be graceful—not so much because the dispersed generating technologies will be so slow to deploy as because persistent needs for temporal balancing of onsite thermal and electrical loads with supplies will justify retaining grid service for quite a while.

This market-driven "withering away of the state" will then make utilities write off remaining central thermal power plants[57]—magnificent engineering achievements which, like open-hearth furnaces and Bessemer converters, are no longer competitive even to run, let alone to build. (I'm already experiencing a twinge of pre-nostalgia just thinking about it.) And so Thomas Edison's original vision of a largely decentralized power system, perhaps even his vision of selling energy *services*—light and torque, not kWh—will at last be fulfilled: just a century late.

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[55] It is not immediately obvious how all these innovations in both mobile and fixed-site uses of natural gas, generally with extremely high system efficiencies, would affect the total demand for this key transitional resource, which is now known to be exceedingly abundant.

[56] Dr. Weinberg, former manager of R&D for PG&E, is at Weinberg Associates, 42 Green Oaks Court, Walnut Creek CA 94596.

[57] This would be a major hit on top of enormous writeoffs of project-financed Asian power plants, most of which will disappoint: they represent the same dumb money, chasing transactional rewards without favorable economic fundamentals, that inflated the 1980s U.S. real-estate bubble. It's not clear which of the two central risks is worse—that the sovereign host won't raise electricity prices to the levels needed to pay for the plants, or that it *will*, deflating demand far below expectations.

Renewables in Integrated Energy Systems

Keynote address to the ANZ Solar Energy Society
Solar '93 Conference, Perth, W.A. (by PictureTel)
3 December 1993

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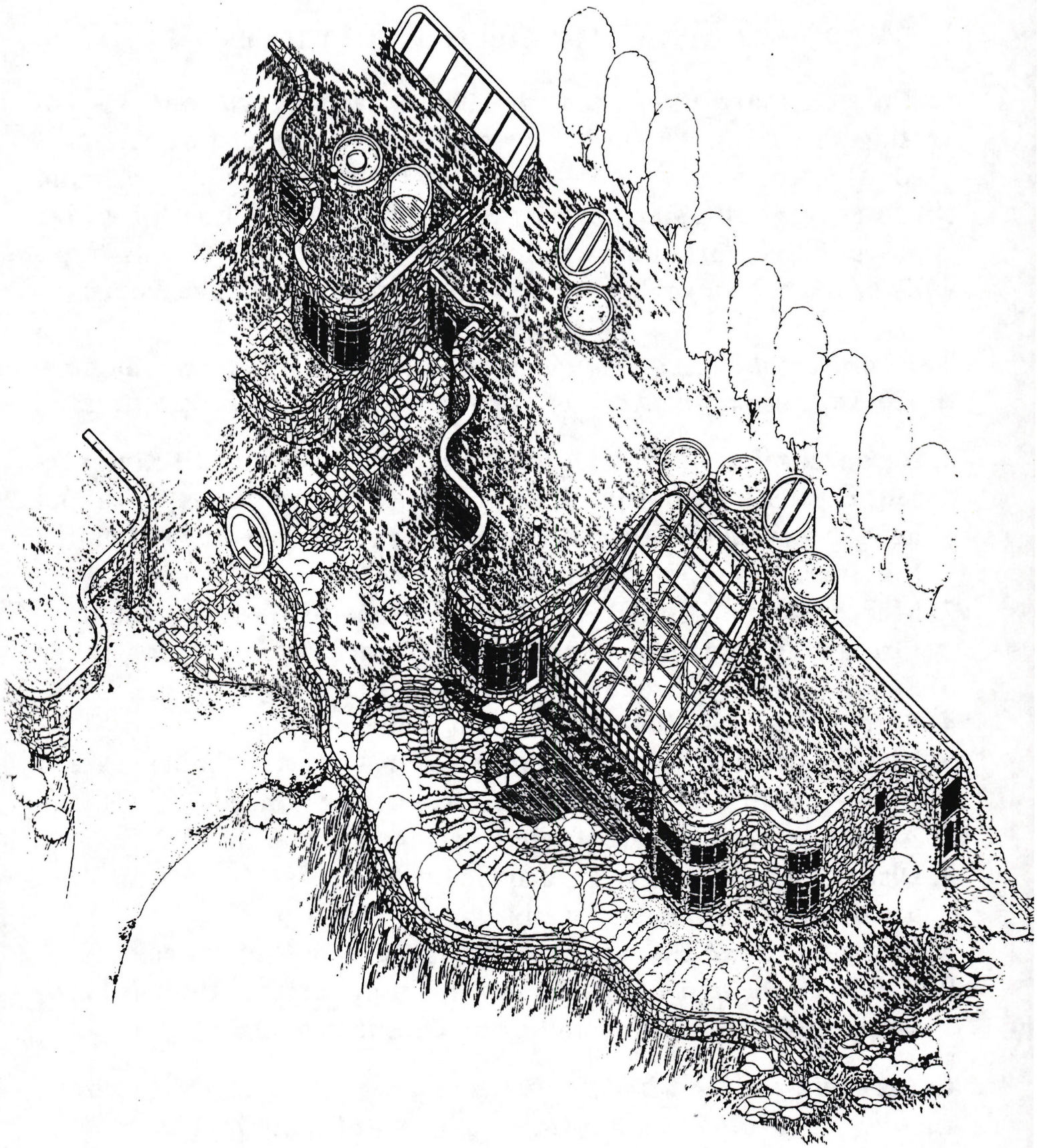
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This research was supported by The Pew Charitable Trusts.

Exhibit No. 5

Efficient end-use helps renewables do more, work better, sell better, cost less, and profit more

- *Domestic water heating:* efficient end-use saves half; reduced standby/distribution losses and proper setpoint (~44°C) raise savings to 62-65% at an average cost of 0.3–0.7¢/kWh; this lets a simple passive downpumper meet ~100% of the family's load
- *Household photovoltaics:* reducing average load to ~40–120 W permits a small, cheap array with modest storage to suffice
- *Office building:* daylighting leverages dimmable supplementary lighting; that cuts internal heat gain, facilitating passive/alternative cooling; lower cooling loads mostly pay for that; workers' productivity gains may be worth ~5–15 as much as all energy
- *Cold-climate house:* passive solar heating eliminates the heating system and cuts construction cost; that saved money cuts the total cost of saving ~99% in space- and water-heating, 50% in water, and 90% in household electricity (US$5/month, 372 m^2) to only $16/$m^2$—a ten-month payback with 1983 technology
- *Hot-climate house:* passive solar heating displaces furnace with hydronic radiant backup; the radiant coil provides enough city-water cooling backup to let further passive measures eliminate the air-conditioner and ductwork too, raising total energy savings to ~80% at negative marginal mature-market cost
- *Biofuels:* ~0.4–1.6 l/100 km "supercars" (ultralight hybrids), and their heavy-vehicle analogues, mean transport needs so little liquid fuel that sustainably growing farm/forestry wastes suffice

With meticulous whole-system engineering, this efficiency/renewables combination is a natural partnership. But it raises important new issues about how properly to value both resources.



What are dispersed electric resources worth?

Utilities compare ¢/kWh costs to choose electricity-saving or -generating resources. The utility's weighted-average cost of capital is used (a) to convert all capital costs into fixed charges per kWh and (b) to convert all variable costs to present value. The utility then chooses the resource that minimizes its total levelized costs (typically at the busbar) or its present-valued revenue requirements.

This universally used method seriously understates the tangible, measurable economic value of dispersed and diversified resources:

1. **Resources that avoid uncertain future costs by substituting present capital investment for future fuel consumption cut risk and hence merit more favorable discounting. So does diversification that increases reliability and resilience.**
2. **More modular, quicker-to-build resources reduce financial, forecasting, and technological-obsolescence risks.**
3. **Smaller units reduce the needed reserve capacity.**
4. **Resources nearer the load cut grid costs and losses.**
5. **Dispersed resources can make the grid more reliable, extend equipment life, and generate reactive power at need.**
6. **Isolated generators can provide premium power quality.**
7. **Dispersed generators can produce valuable waste heat and can use otherwise valueless locally available fuels.**
8. **Many dispersed resources produce greater output onpeak.**
9. **Relatively benign resources can avoid important (though hard-to-quantify) social costs and bring unique benefits.**

Collectively, these advantages mean that seemingly costly resources, such as photovoltaics, are often strictly cost-effective <u>today</u>.

Risk-reducing choices are worth more

We focus first on four main kinds of risk:

- **uncertainty of future operating costs, *e.g.*, for fuel**
- **uncertainty of demand, hence the risk of buying too much or too little supply**
- **uncertainty of economic conditions, *e.g.*, interest rates**
- **technological obsolescence, hence the risk of buying the wrong resource**

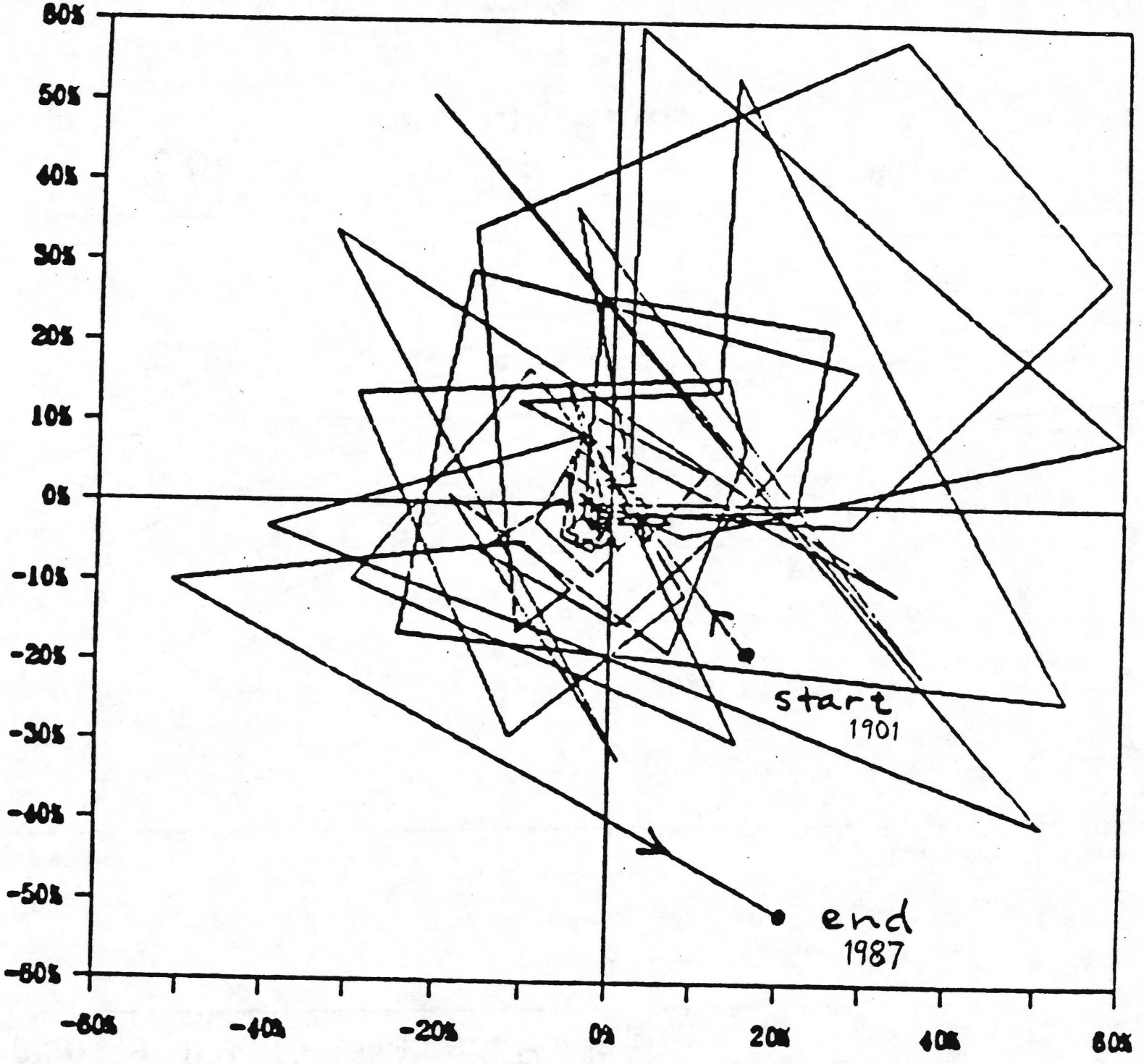
To manage these risks so as to minimize regret requires choices that are relatively small, fast, modular, and cheap and that minimize long-term expenses about which least is known. Such resources' economic value can be quantified using financial theories developed to manage market risks.

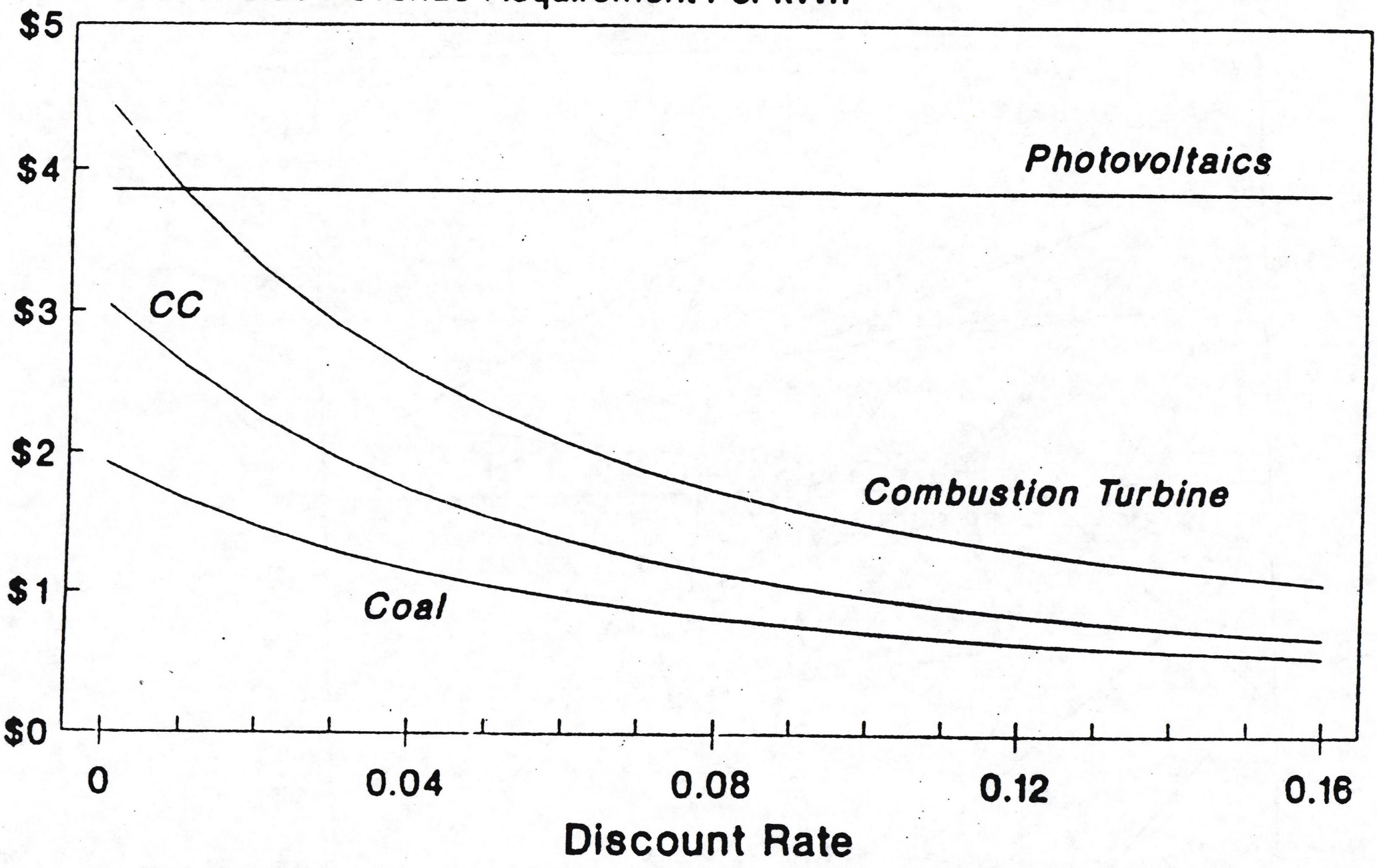
Other important kinds of risk will be considered separately.

Uncertainty of future operating costs

The value of resources that pay more now for equipment and less (or nothing) later for fuel has been analyzed by noted U.S. financial consultant Dr. Shimon Awerbuch:

- **Utilities' economic comparisons currently *ignore* technologies' different exposure to fuel-price volatility, which represents a risk with an economic value. This makes a fuel-intensive option look cheap (say, 5 US¢/kWh for combined-cycle gas) and fuel-free photovoltaics expensive (say, 25¢/kWh).**
- **That's like saying that a $1,000 junk bond yielding 16%/y has a greater present value than a $1,000 Treasury bond yielding 7%/y. In fact, the former's default risk may deserve, say, a ~25%/y higher discount rate, outweighing its potential yield!**
- **Each project, and each cashflow *component of* each project, should be discounted at its proper risk-adjusted rate. Risky cash *inflows* deserve high discount rates ("a bird in the hand is worth two in the bush"); risky cash *outflows*, low or negative rates.**
- **Since oil prices are statistically random, we don't care when we buy oil, so its real discount rate is 0%/y. A relatively stable fuel price like coal might merit ~3.5%/y.**
- **Outflows with low price uncertainty and volatility—*e.g.*, property taxes, fixed O&M, and working capital—are like debt and should be discounted at WACC, *e.g.*, 5.5%/y.**
- **"Composite" discount rates weighted for various cash *outflows* could therefore be *e.g.* 4.5%/y for gas combined-cycle, 6.5%/y for coal-steam, and 11.5%/y for photovoltaics. (For outflows, higher means less risky.) Just this simple risk adjustment can make photovoltaics, at today's prices, cheaper than gas combined-cycle!**


60%
50%
40%
30%
20%
10%
0%
-10%
-20%
-30%
-40%
-50%
-60%
-60%
-40%
-20%
0%
20%
40%
60%
start
1901
end
1987


Present Value Revenue Requirement Per kWh
$5
$4
$3
$2
$1
$0
Photovoltaics
CC
Combustion Turbine
Coal
0
0.04
0.08
0.12
0.16
Discount Rate

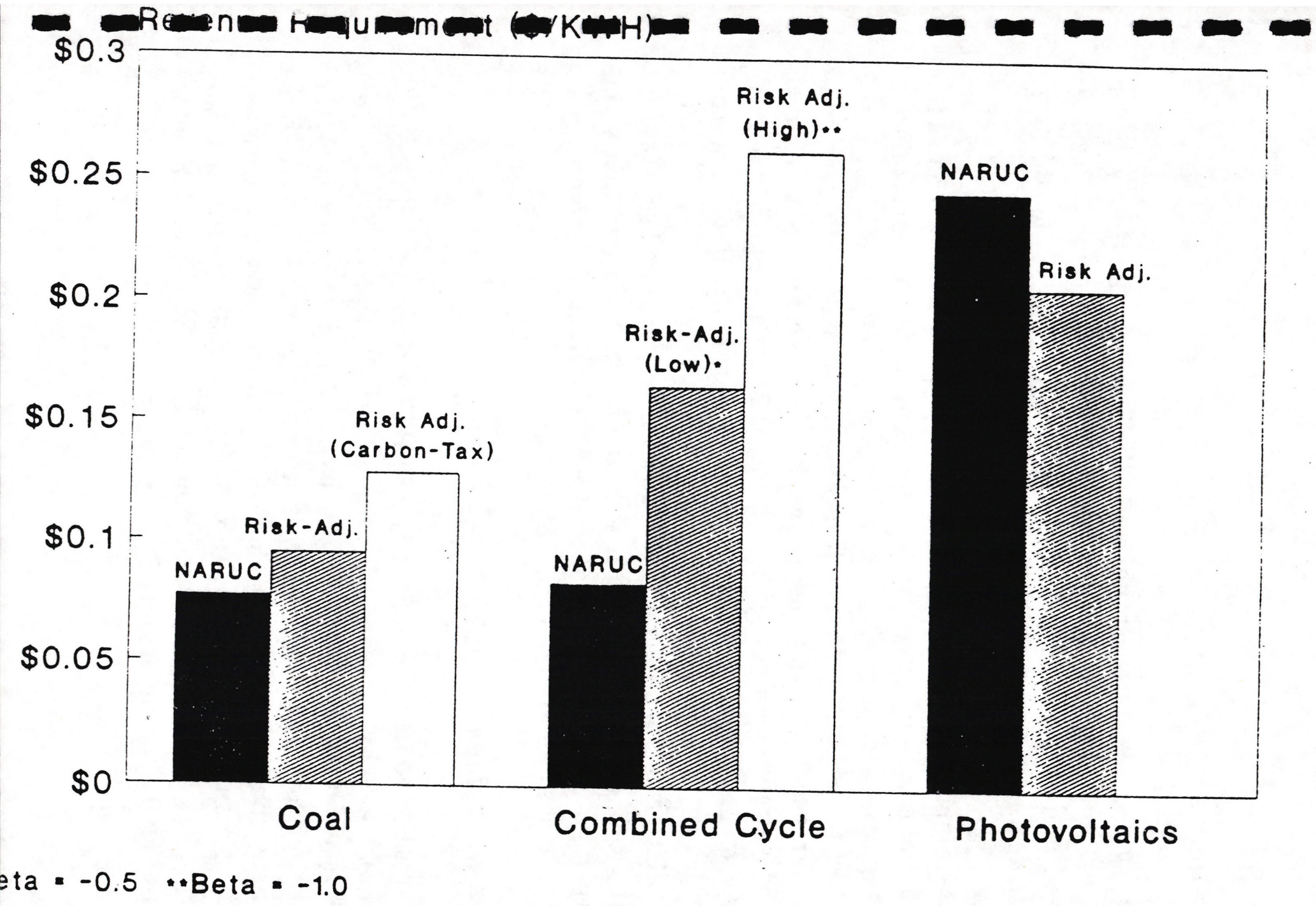


Figure 5. NARUC base-case and risk-adjusted revenue requirements

Uncertainty of demand

The longer the forecast horizon, the greater the likely error. There's no escape from the risk of mistimed demand forecasts during a plant's *operating* life, but that risk can be reduced during *construction* by building smaller modules in shorter times.

A Los Alamos National Laboratory study found that to achieve the same financial objectives under the same external uncertainties, it's typically worth paying three times as much "overnight cost" per kW for a power plant with a 2½-year as with a 10-year construction time (or five times as much at 15 years). Yet many dispersed resources have lead times not of 2½ years but of months, weeks, or days, so their reduced planning risk is worth even more.

A similar risk-reducing value should exist for mistimed *grid* investments: EPRI estimates $1.50 is invested in the U.S. grid per $1 in generation, and it is even more difficult to forecast demand accurately for a small area than for a large area.

Exposure to financing risks

The more modular a resource is and the shorter its construction time, the less its exposure to inflation, real escalation in factor costs, regulatory changes, etc. Of course those changes can still occur, but you can switch at any time to a resource better suited to the new conditions, rather than being stuck partway through building a single, monolithic unit. Further, small investments can *buy time*, so we can learn more and hence make better (or defer indefinitely having to make) big investments.

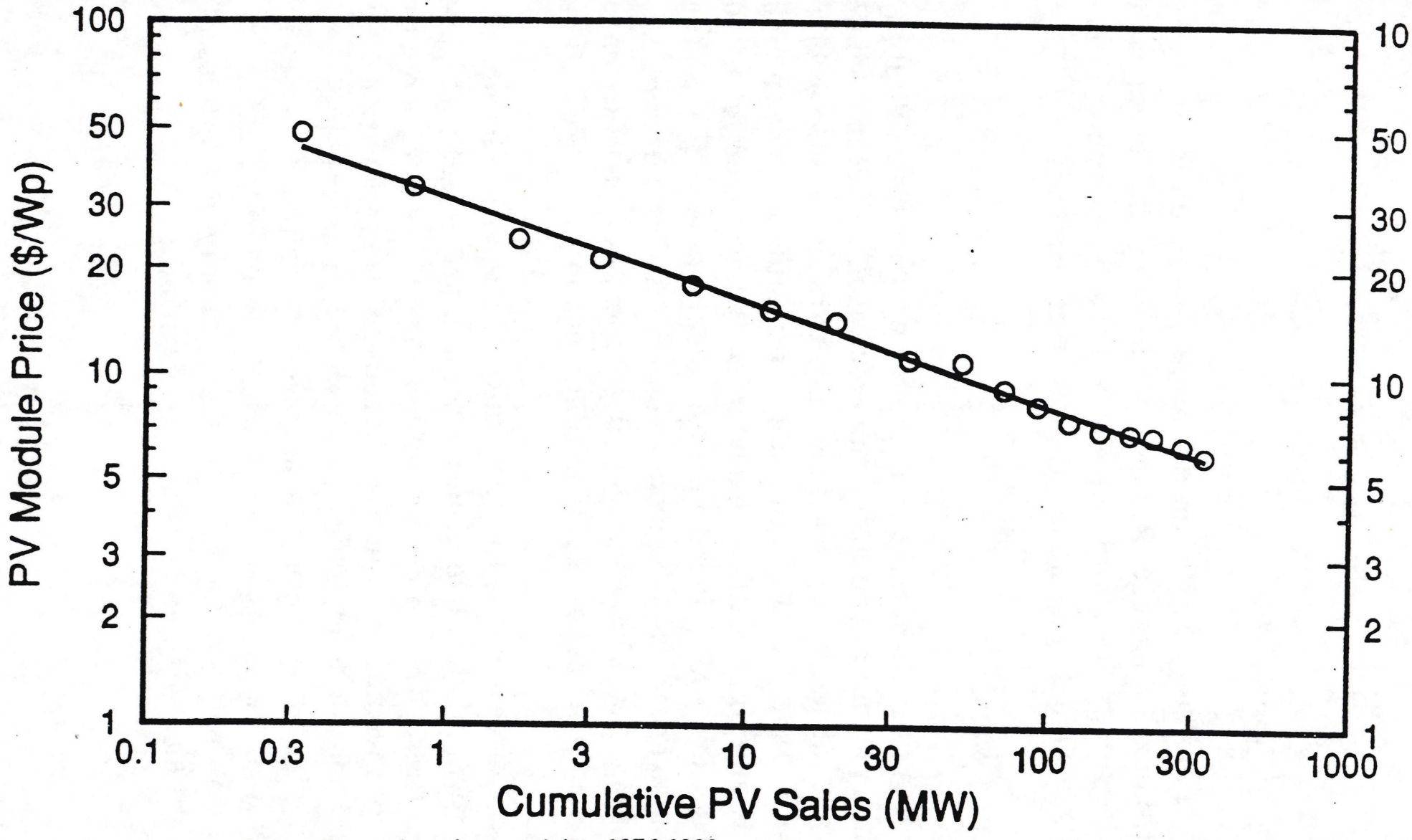


Figure 6: Log-log plot of the selling price of pv modules, 1976-1992.

The pv module selling price follows closely an 81.6% experience curve. Module sales data and prices are from Strategies Unlimited Mountain View, CA, September 1993. Strategies Unlimited used the Consumer Price Index to convert current prices into 1992 price

Technological obsolescence

Small, modular, build-as-you-need, pay-as-you-go units cut exposure to technological change. Rather than freezing the design early for one big, lumpy, inflexible resource, they let continuous improvements be rolled incrementally into successive modules.

Evolution of costs

In general, central thermal plants have neoclassical supply curves—the more units you build, the *more* each one costs—while efficiency and dispersed renewables have experience curves: for photovoltaics (1976–92), each doubling of cumulative production has *cut* real marginal cost by nearly 20%. Policymakers charged with a long view and a social purpose should assess PVs at the "mature market cost" they'll pay once many have been bought, because assuming they will be cheap will get them bought and hence actually make them cheap—a self-fulfilling prophecy.

Dispersed resources exploit the economies of mass production. By making powerplants less like cathedrals and more like cars or personal computers, we exploit continuous improvement, modern manufacturing techniques, and highly competitive innovation. We move labor from the field, where productivity gains are sparse, to the factory, where they're huge. And since the equipment comes in small, quickly made pieces, lessons learned can be immediately incorporated into new production, condensing many generations of technology into a short time, just as with electronics.

Diversification

Public policy often favors, and pays extra for, fuel diversity for strategic reasons. Putting all eggs in one basket risks having one's economy halted by events beyond one's control: oil embargoes, coal or rail strikes, bad weather that disrupts fuel transport, nuclear accidents that elicit calls for widespread shutdowns, or the accidental or deliberate disruption of fragile networks like the gas or electric grids.

Protection from such mishaps is both direct and indirect: indirect because the more diversified the options, the less the power of deliberate disruption (embargoes, strikes, terrorism), hence the less the motive to undertake it.

The kind of supply interruption that macro-diversification is meant to prevent is not fully reflected in price uncertainties. Of course prices go up during an oil embargo, but during some kinds of interruption, such as failure of a gas pipeline to an area served by no other, the gas simply isn't available there, so its price is meaningless. Presumably this kind of risk and the value of avoiding it could also be expressed by appropriate discount rates.

More diverse, dispersed, renewable sources also provide a subtle property, resilience, that can make major failures *impossible.* Resilience depends on a system's architecture: its reliance on relatively fine-grained, richly interconnected, redundant, cooperative, loosely coupled modules that are diverse, have low failure costs, are easily repaired, are hierarchically organized so failures at one level have little affect on another, and fail gracefully.

Smaller units save reserve capacity

When a big unit dies, it's like having an elephant die in your living-room. You need a second elephant, equally big, to haul the carcass away. Standby elephants are expensive.

Power plants need two kinds of standby capacity: "reserve margin" available if needed, and a portion of it continuously synchronized to the grid as *instantly* available "spinning reserve." Both cost capital, and spinning reserve burns fuel. In Los Angeles, spinning reserve *capacity* alone is worth ~0.1 ¢/kWh (1991 US$).

The smaller the units, the less capacity is likely to fail at once, because failures tend to happen per unit, not per kW. At least for thermal power plants, smaller units are also intrinsically more reliable than bigger ones. Thus a Los Alamos comparison of two sets of coal-fired stations 4 x 750 MW *vs.* 9 x 250 MW, in the range where economies of scale are supposedly clearest found that:

- **the bigger plants needed one-third more total capacity**
- **the smaller plants would be 19% more available, have a 59% lower forced outage rate, and take 44% less time to build (5 years instead of 9)**
- **but the smaller plants would have 15% worse heat rate, 11% higher capital cost/kW (assuming economies of scale four times as strong as the U.S. actually observes), and slightly higher costs for transporting coal and electricity**
- **nonetheless, the smaller plants would have 1% lower operating costs, 17% lower construction costs, and 6% *cheaper* electricity**

Options 10^5 smaller should tell the same story even more strongly.

Resources nearer loads cut grid costs and losses

Line extension and grid connection

The most familiar case for photovoltaics is for rural households who would otherwise incur high costs for line extension: in the U.S., commonly ~$11/m overhead or ~$21/m underground, plus future maintenance costs. Some utilities therefore lease PVs instead—seldom doing strong end-use efficiency first, however! Typical lease fees, including perpetual maintenance, are $125–250/month for PG&E, 5% + 1.6%/month for Idaho Power.

Depending on climate, load, and AC or DC supply, the breakeven household line-extension distance can be as small as ~400 m. But this distance approaches zero for *e.g.* outdoor walkway lights (PVs for this small load are cheaper than burying a cable), alley lights in Sacramento ($3k for PVs *vs.* $5k to connect to the grid and pay for meters, meter-reading, and kWh), electric fence chargers, etc.

In Eindhoven, Dutch physicist Kees Daey Ouwens got a ~10–12-y payback from powering his house with standalone PVs (after reducing his average load to only ~50 W) from saving energy costs plus the drop and service entrance from the nearby pole. This was so surprising that he installed standalone PVs and efficient end-use devices throughout an Indonesian village, rather than tapping into a nearby transmission line and paying for stepdown, switchgear, and wiring the village. Using 10-y amortization and the utility's interest rate, the people *had a positive cashflow*—because the debt service cost less than they'd been paying for lighting kerosene and radio batteries! Might this also be true for 2+ billion other people?

Grid losses and costs

End-use efficiency or local generation reduces I^2R grid losses in three ways: electrons flow for a shorter distance (less R), at lower currents (less I^2), and reduced peak loads reduce the heating of conductors and transformers (less R). (On peak days, heating by current and weather doubles the average U.S. grid loss to 14%.)

An analysis of fuel cells for Los Angeles substations found that in general, displacing 1% of remote supply by a local resource cuts downstream grid losses by 2%. This reduction in transmission, stepdown, subtransmission, and substation losses was worth 0.3–1.7¢/kWh, depending on location. PG&E found 0.73¢/kWh.

Local resources can also permit more efficient operation of the distribution system, *e.g.*, by swapping transformers and shifting loads among substations to increase [usually low] capacity utilization, or by facilitating interconnections with adjacent utilities. Load-leveling in turn helps equipment run cooler, further reducing losses.

PG&E's marginal distribution cost/kw ranges from $50 to $2,000. "Precision-guided programs" target end-use efficiency on the applications and areas that best defer distribution investment—aiming demand-side investments like a rifle instead of a shotgun. In some circumstances, freed-up grid capacity may also permit valuable power interchange or wheeling.

PG&E found substation photovoltaics could save $25/kW-y worth of transmission capacity, and save another $4/kW-y by reducing voltage tapchanges, lengthening their maintenance interval 40%.

Resources nearer loads boost reliability

Dispersed resources reduce electrons' "haul length," so the power flow is less exposed to mishaps in the grid, where >90% of all outages originate. Such resources are also often intrinsically more reliable than central thermal plants: availability is often 99+% for well-designed photovoltaics, wind turbines, fuel cells, efficiency improvements, etc. Their downtime is also usually very short.

Dispersed resources' biggest reliability advantage is giving utilities more options for isolating and bypassing distribution faults. Local generation helps maintain service to many customers who would normally have to be cut off pending the repair.

This increased reliability has a value that is hard to measure but can be very high (especially for, say, an iron lung or a paper machine). PG&E's customer surveys suggested that an avoided kW-h of outage was worth an average of $29, so substation PVs would add reliability worth $130/kW-y or ~5.6¢/kWh.

Dispersed resources can disproportionately cut peak loads. This makes grid equipment run cooler and hence last longer, reducing forced outages and deferring significant replacement investments. Each ~10 C° decrease in operating temperature roughly doubles equipment life, and temperature falls steeply as peak loads are relieved, especially on hot days. PG&E's substation PVs cool a 10.5-MVA transformer by ~4–7 C°, extending its life ~5 y, worth $89 per PV kW-y or 3.8¢ per PV kWh. And tapchangers that need to change line voltage less often also last longer, saving another ~$10 per PV kW-y by deferring their replacement.

Dispersed generators provide reactive support

Utilities generate, meter, and sell "real" power whose current is in phase with its voltage. However, they must also generate and transmit, but can neither meter nor sell, "reactive" power whose current is out of phase with its voltage. Reactive power can do no useful work; it is a pure cost with no benefit.

Utilities therefore seek to minimize reactive power by penalizing customers with a low "power factor" (the fraction of the power delivered that can do work) and by installing compensating banks of capacitors, *e.g.*, at substations. Capacitors aren't cheap, but they are vital to maintaining adequate circuit voltage to run the distribution system.

Resources close to loads decrease reactive power by shortening wires and avoiding transformers, both sources of inductance, and by reducing current through those inductive components. Reactive losses vary as the square of current, so a 1% drop in current decreases reactive losses by ~2%.

Dispersed generators with their own inverters can also adjust themselves instantaneously to change the phase angle between their current and voltage outputs, generating reactive power needed to compensate for reactive losses elsewhere in the circuit. The same kW of generation cannot be real and reactive at the same time, but sometimes reactive power is more valuable. This ability to displace capacitors at need is worth ~0.4–2.9¢/kWh at a PG&E substation.

End-use efficiency, *e.g.* motor inverters, offers similar advantages.

Typical Design Goals of Power-Conscious Computer Manufacturers

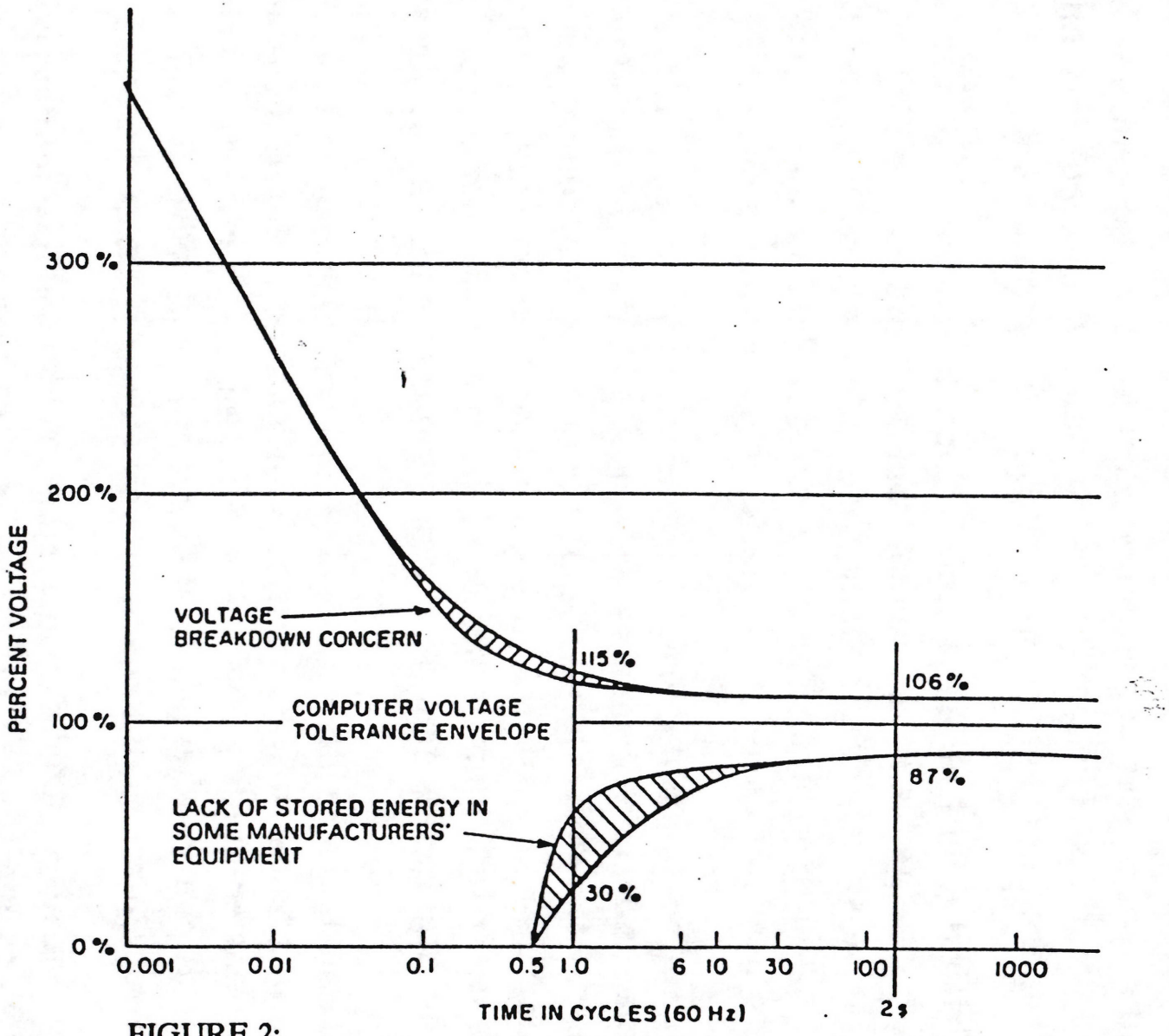


FIGURE 2: Computer and Business Equipment Manufacturer's Association (CBEMA) Curve

Isolated generators can provide premium power

Increasingly many uses demand power with a pure sinewave form, no spikes or other transients, and extreme reliability. Yet the diverse uses on the grid, including noisemakers like welders, create many undesirable power disturbances. Just transients from lightning, switchgear operation, etc. can overwhelm delicate electronic applications. This can range from annoying to possibly fatal (*e.g.*, in operating rooms or aircraft-control computers).

Critical applications require "uninterruptible" power supplies (UPSs)—typically a rectifier, battery, and inverter, plus control gear to switch over instantly if needed. The UPS is run from the grid, but if prolonged outages are possible, a standby generator is also needed to keep the batteries from running down.

In applications like ground avionics, where air traffic control beacons and similar devices must run ultrareliably in often remote areas, the cost of buying, fueling, and maintaining the standby generator may justify using photovoltaics instead, as is already done for lighthouses and for highway signs and emergency phones. This also avoids generator switching transients and outages.

If the site is grid-connected, PV power also avoids lightning and similar transients. For critical applications with stringent demands for power quality, even when grid power is already wired to the site, it can be cheaper to start from scratch with an isolated solar power source than to back up and clean up the grid power!

Even grid-connected dispersed generators may soon provide active power conditioning, offsetting grid transients and harmonics.

Dispersion creates integration opportunities

Central thermal power plants generate ~1-3 GW of waste heat in one place—far more than most applications can use, and usually too far from thermal loads to justify the cost of transporting it. Dispersed resources, however, typically provide a convenient amount of waste heat conveniently close to the end-use. Thus a fuel cell's or Stirling engine's waste heat can heat or cool buildings or run industrial processes. Even on a rooftop scale, heating domestic water with low-temperature waste heat from photovoltaics in a low-concentration nonfocusing concentrator (Winston collector) can displace fueled water-heating while boosting cell efficiency.

Thermal power cycles can often provide not only cogeneration of electricity and waste heat but even trigeneration, with an additional output of useful heat at a different temperature.

Integration opportunities extend also to new fuels. Many industries produce modest quantities of combustible byproducts, from food-processing wastes to refinery offgas, that cannot be economically transported for long distances. Onsite power production changes these byproducts from a costly disposal problem into a valuable output. Often both this new-fuel opportunity and thermal integration are available simultaneously.

Displacing idle-at-night fossil plants saves fuel

Peak-saving resources can displace smaller plants kept warm at night for daytime near-peak use, avoiding their minimum-load inefficiency. This reduces operating costs (~1¢/kWh) + air pollution.

Many dispersed resources shave peak loads

Most end-use efficiency disproportionately cuts peak loads. But so do many renewables. Photovoltaics work best, and are typically ~75–85% dispatchable, on the sunniest days when cooling loads peak. The same hot weather drives strong winds through California mountain passes filled with turbines. Together, wind-plus-photovoltaic output nicely matches many California loadshapes. Thus the renewable electricity is available at the times at which it is most valuable because the costliest supplies are being used.

End-use efficiency yields a similar benefit in the context of demand forecasting. Once built, a power plant has fixed output. But a factory with more efficient motors saves even more electricity if it adds an extra shift, and a shop with more efficient lights saves even more electricity if it stays open longer hours. Thus the savings automatically expand in precisely the conditions of rapid load growth that make them most valuable to the utility. This property of end-use efficiency—but not of power plants—amounts to a form of load-growth "insurance" with an economic value.

Dispersed resources can prevent pollution

Efficiency and renewables avoid air pollution worth (and often sellable for) ~0.8–2.0¢/kWh for a Los Angeles fuel cell. In areas with poor air quality, saving peak loads is especially valuable because it saves NO_x from combustion turbines on the hottest days when smog forms most quickly. Moreover, just the *powerplant O&M* cost avoided by displacing a common NO_x-control technology in Los Angeles is worth ~0.4–0.7¢/kWh.

Dispersed resources' most valuable benefits may be NEEDS ("Not Easily Expressed in Dollars")

Relatively benign and dispersed resources can often:

- **resolve NIMBY/NIMBL conflicts by reducing impacts**
- **ensure equity by giving the energy and its side-effects to the same people at the same time**
- **improve public and occupational health and safety**
- **reduce noise and ugliness, improve amenity**
- **enhance community and individual autonomy**
- **be more equitably available through more vernacular technologies rather than requiring highly specialized and dominating institutions, hence strengthen the periphery against the center**
- **permit and require institutions that learn faster and hence are more adaptable to social/technical change**
- **fit a more efficient and accountable institutional scale**
- **yield more, longer, and better jobs, more diverse in occupation and location, usually free from boom-and-bust and construction-camp problems**
- **improve the balance of trade (fuels, skills, equipment)**
- **avoid irreversible commitments of scarce resources**
- **provide better working and living conditions, hence better worker productivity (worth an order of magnitude more than eliminating energy bills!)**
- **incur smaller administrative overheads**
- **be likely to make smaller, less consequential mistakes and learn from them more cheaply and quickly**
- **reduce cleanup and disposal problems afterwards**
- **practice stewardship instead of stealing from our kids**

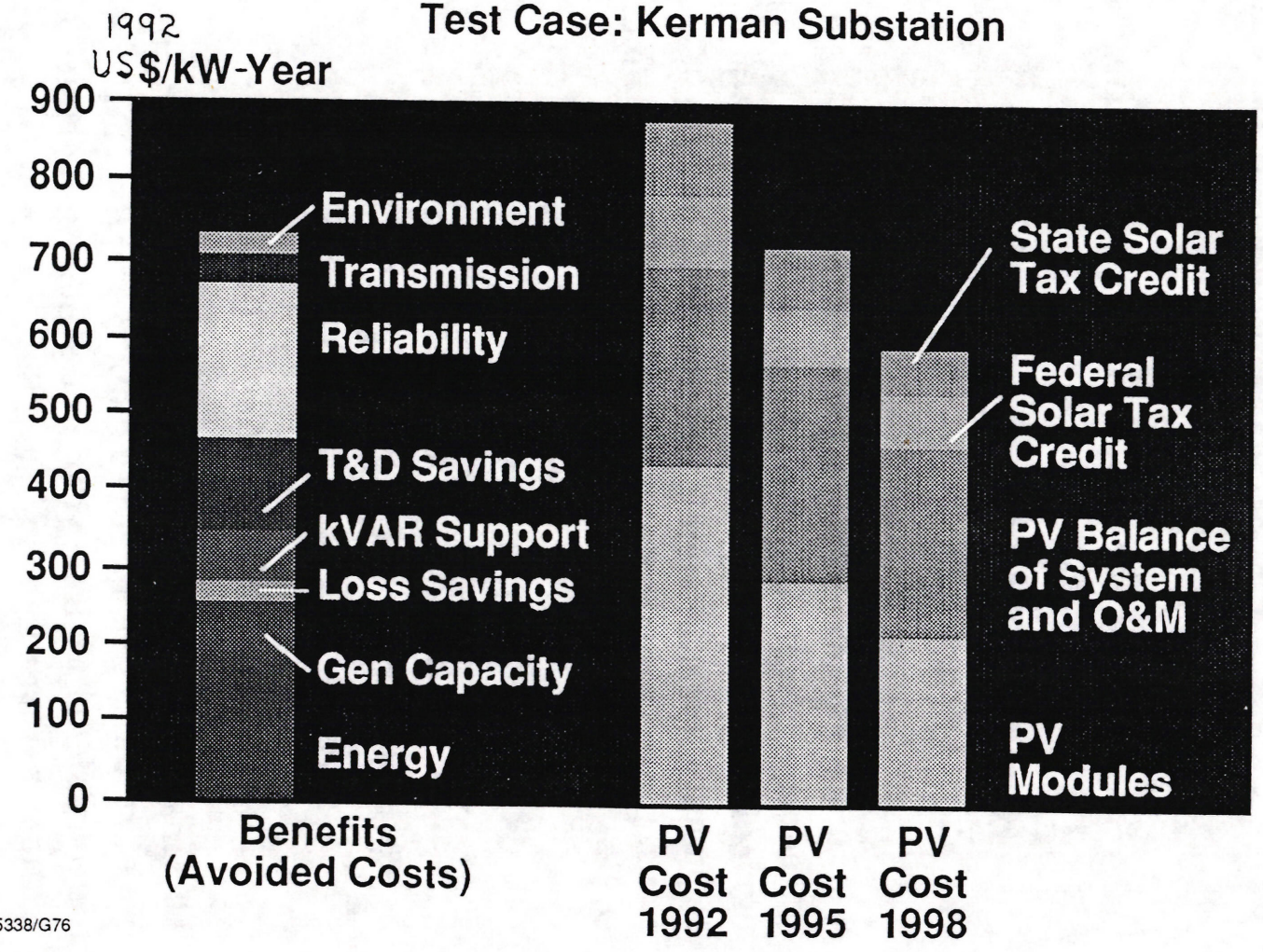
How do these benefits all add up?

PG&E installed a 500-kW_p 1-axis-tracking PV array in May 1993 on its Kerman substation to save money. It calculated distributed-resource benefits worth 1.8x the value of avoided energy and capacity. Including these benefits—all real, tangible, valuable reductions in utility costs and risks—cut the 1995 PV cost from the apparent ~25¢/kWh (net of 5¢/kWh tax credits) to ~8¢/kWh, less than avoided energy and capacity costs. But this still didn't count:

- **Awerbuch's risk-adjusted discounting of the fuel-based avoided cost (*e.g.*, counting the risk of fuel-price volatility can readily double the cost of combined-cycle gas generation)**
- **any photovoltaic cost reductions after 1995**
- **reduced planning risk in generation and grid investments**
- **reduced exposure to financial and technological risks**
- **greater fuel diversity and system resilience**
- **reduced reserve margin, spinning reserve, and minimum-load operational costs**
- **line extension (none to be avoided in this substation installation)**
- **opportunity to sell premium-quality power (not possible here)**
- **thermal integration and local-fuel use (none in this case)**
- **reduced payments to private generators based on lower average system cost (a system benefit worth 2¢/kWh)**

In many cases, counting appropriate omitted benefits would make the economic case even stronger. But if it is persuasive for photovoltaics, today's costliest dispersed renewable option, it must be stronger still for many cheaper generating options, and overwhelming for most end-use efficiency improvements. We clearly need a complete overhaul of how such resources are valued.

Benefits vs Costs of PV in T&D Systems



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First in a Series

Who Will Power Hawaii's Future?

It's a brave new world when it comes to power. Imminent deregulation, new sources of alternative energy, and technological advances are among the factors affecting the way utilities, utility commissions and municipalities around the country view the business of providing power.

In California, where deregulation is underway, Glendale municipal utilities are considering a partial merger in an attempt to stay competitive. They are worried that increased competition will bring rates down, and that to compete they will have to become more efficient. In Massachusetts, with deregulation still several years away, utility companies are already restructuring and downsizing.

And of course there is the debate over who will reap the benefits of a competitive utility market. While some claim that rate reductions will only apply to those with bargaining power, i.e. large users, others hope that cost savings will eventually reach residential consumers.

Already, the Wisconsin Electric Power Co. (WEPCO) has been very successful in its restructuring, shaving off millions of dollars in construction, payroll and other operating expenses since 1994. This summer WEPCO requested permission to merge in what some are calling the largest electric utility merger in America's history. Meanwhile, consumer advocates and large industrial customers petitioned the state Public Service Commission to investigate why WEPCO's customers had not received a $100 million rate cut to reflect the company's huge savings.

In this state, Hawaii Electric Industries (HEI), the parent company to Maui Electric Company (MECO), reported record earnings in 1994, and has already reported an increased net income of $9.8 million (or 18%)for the first nine months of 1995. This increase was attributed to the improved financial performance of the HEI's utilities.

Not only has there been no word of passing HEI's good fortune on to consumers, but MECO has just requested a 19.2% rate increase.

Last week's Maui News reported that this increase would raise Maui residential bills by about $15.15 per month. Taxpayers will also pay -- one way or another -- for the County's increased electric bill. In 1994, the County paid about $7.16 million in electric bills, including for example, usage at the County building, water treatment plants, and county parks, as well as the cost of lighting our streets. A 19.2% increase for MECO means $1.4 million added to the County budget.

Last month it was revealed that school budgets could not accommodate current electricity costs, and that money may have to be diverted from educational programs. If MECO's rate increase is approved, Maui residents will end up paying for the increased financial burden on schools through state taxes, losses in other state services, and, most likely, through a compromised education for their children.

Increased electricity costs will also certainly impact Maui businesses. While the Maui Chamber of Commerce endorsed MECO's plant expansion at Ma'alaea, the organization and its former chair Tom Jezierny (MECO's president) have said little about the burden on the business community of rate increases that follow facility expansion.

This summer MECO representatives met with the community to discuss the future location of MECO's "new generation site." They distributed fact sheets stating that MECO needed to establish a new power plant site to address additional power needs projected for beyond the year 2004.

In contrast. Polson, Montana utility providers are facing a "power-market glut" due to hydroelectric and natural gas surpluses, a slower-than-predicted growth rate, deregulation, new power generation facilities, and technological advances. As residents of that northwestern community experience rate decreases, Maui residents need to consider their own future. They need to learn more about renewable energy technologies now available to our islands, world-wide market factors affecting procurement of energy and its distribution, and their rights as residents regarding its control.

Access ◉5007 for the May 30 Pacific Monitor: "How Powerful is the State Public Utilities Commission?"

PM

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Second in a Series

Who Will Power Hawaii's Future?

This summer, Maui Electric Company (MECO) met with residents of Kihei, Kula, Paia, Pukalani, Makawao, and Kahului to discuss three possible sites for a new 50-acre power plant to provide for Maui's power needs after 2004. The stated purpose of the meetings was to get feedback from each community about which of the three sites –. two on Pulehu Road and one in Kihei – was most desirable. According to MECO accounting manager Duayne Hayashi, most of the communities were opposed to the site nearest them.

One exception was Makawao. At a meeting hosted by the Makawao Main Street Association in August, many of those present felt that MECO had not provided adequate justification for increasing power generation at all. When they questioned Tom Jezierny about the basis for the prediction that 232 MW (megawatts) of electrical power generation capacity would be needed over the next 30 years, the MECO president maintained that forecasts of future power needs were not based on population growth. However, when asked, Jezierny would not reveal what data MECO's projections were based on.

In an interview last month, Hayashi stated that the plans for the new site were based on anticipated growth needs in the business and industrial sectors. He cited the opening of a new Sheraton, A&B's new non-residential developments, and increasing needs in the scientific and hi tech communities at Haleakala and in Kihei. By projecting that 232 MW of additional power will be needed by non-residential users over the next three decades, MECO seems to be predicting that the demand for electricity among Maui businesses and industry will nearly triple during that time.

Just how much power is 232 MW? With the watt being the basic measure of electricity, a kilowatt is 1,000 watts and a megawatt is 1 million. While 75 watts will power a light bulb, it takes about 4.5 kilowatts to run the average U.S. home. So 232 MW is enough electricity to power more than 50,000 homes. While MECO is planning to increase its power generating capacity by 232 MW on Maui, the European Commission expects new electrical power capacity in all of Western Europe to only rise between 30 and 190 MW between now and 2020.

How can Maui's need for increased power capacity be nearly equivalent to that of Western Europe? Part of the reason for this can be attributed to the European community's strong commitment to technology which promotes energy efficiency and to vigorous energy conservation efforts – which substantially reduce the need for additional capacity.

A number of Maui residents seem to believe that MECO has just not provided enough evidence to support its claims that an additional 232 MW of capacity will be necessary. So at the August Makawao meeting, residents actually voted for a fourth option of their own making – no expansion of any kind until data is made available demonstrating the need. According to Hayashi, the Makawao option was "not really considered," and since all other community input seemed motivated by a "Not in My Back Yard," attitude, MECO will probably choose the site that best suits its own needs.

A Fact Sheet distributed at the community meetings, stated that the site selection target date was set for August 31, 1995 and the site acquisition target date was December 31, 1995. Although no site has been officially chosen, Hayashi is confident that initiation of the land acquisition will still meet the December 31 deadline. Hayashi estimated that the land will cost somewhere between $1 and $3 million, and the first phase of the generation plant somewhere in the "ballpark" of $150 million.

Since MECO is already considering its role in the provision of power thirty years from now, Maui residents should be seriously considering all of their options now.

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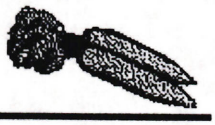


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Third in a Series

Who Will Power Hawaii's Future?

For the last few weeks, the Pacific Monitor has been examining the various questions surrounding the provision and distribution of power in Hawaii. Two weeks ago, we looked at the rising cost of electricity for Maui residents, what the impact of rate increases will have on public services and small businesses, and what kinds of changes imminent deregulation will bring.

Last week, we considered the future plans of Maui Electric Company (MECO), specifically its goal of constructing a 232-megawatt (MW) generator. MECO's projections make many assumptions. One is that Maui's business and industrial sectors will increase their power use three-fold in the next thirty years, and the other is that gas-turbine electricity production will continue to be a competitive means of producing power thirty years from now. Recent events demonstrate just how critical it is for the general community that projections of electrical need and capacity be accurate.

Last Tuesday, the Duff & Phelps Credit Rating Co. (DCR) assigned a 'BBB+' rating to MECO's parent company, Hawaiian Electric Industries (HEI). In determining HEI's financial strengths and weaknesses, the credit rating agency pointed out that "demand growth at [HECO] has been satisfied by a mix of purchased power plus investment in plant, which has and continues to require equity infusions from HEI and regulatory support." In other words, there are currently no additional power needs waiting to be fulfilled in Hawaii.

However, DCR notes that even though there are not additional rate payers to cover current costs, the willingness of the Hawaii Public Utilities Commission (PUC)"to authorize supportive interim and final rate orders that underpin HECO's credit quality," alleviates their concern that HECO's financial health seems dependent upon steadily increasing rates.

Thus the DCR believes that in spite of a lack of growth potential for HECO by way of a sizable increase in demand for electric power, the support of the PUC of periodic rate-increases appears to justify a relatively positive credit rating.

The credit agency further notes that "HECO's retail rates are high by mainland standards. Although isolation limits retail/wholesale wheeling issues, HECO could feel the competitive pressure exerted by nonutility generators, energy service companies and demand-side management programs."

Besides being the "parent" to MECO, HEI also owns HELCO -- the Big Island's Hawaii Electric Light Co. Apparently the DCR rating agency was right to note the potential "competitive pressure" of independent power producers (IPPs). According to a filing made by HEI with the Securities Exchange Commission (SEC) last month, HELCO may end up writing off a sizable portion of the $41 million it has invested so far in a new 56-MW generating unit on the Big Island if it is forced into a power purchase agreement with two IPPs. The two independent power companies are claiming that they are entitled to a power purchase contract to provide HELCO with additional capacity. If the power purchase agreements are approved, the additional capacity provided by the IPPs would make the 56-MW addition unnecessary. The costs already incurred in putting the 56-MW unit into service total $41 million. In its SEC report Hawaiian Electric Industries said that HELCO "might be required to write off a portion of the incurred costs *if such costs ultimately are not recoverable from customers or others*." (emphasis added)

In the same way, the law also requires that MECO purchase power for the avoided cost. That means that if another utility provider can produce the energy cheaper than MECO can, Maui's utility must buy the power from the private producer. As on the Big Island, if MECO already has its 232-megawatt (MW) generator under construction and an IPP can provide the power cheaper, MECO (and most likely its rate payers) must eat the cost of its unneeded plant.

PM

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Exhibit No. 6

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Jonathan Waxman Fund

TEL: 244-5301

The JDW Memorial Sports and Cultural Festival is Dec. 29th and 30. Find out how to get involved.



1033

Maui Architectural Group

TEL: 871-1190

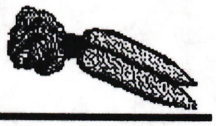
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Forth in a Series

Is Renewable Power in Maui's Future?

Although Maui's natural endowments do not include oil, gas or coal, the Valley Isle is blessed with an abundance of renewable energy resources – sun, wind and biomass among them. So it does seem possible, given recent technological advances, that renewable energy will supply a large portion of Maui's future power. Yet Maui Electric Company, Inc. (MECO) does not seem to be making much room for renewables in its future plans. When asked in a recent *Pacific Monitor* interview why MECO does not choose to invest in alternative energy, accounting manager Duayne Hayashi stated that though MECO was "more than willing to contractually buy power from alternative energy producers," the company could not jeopardize rate payers by investing in " technology that's not proven."

Interestingly, much of the rest of the world seems take the development of renewable energy quite a bit more seriously. In fact, from an international perspective Hawaii is considered to have the potential to play a serious role in the future of renewables.

This past September, representatives from 13 member countries of the Asia Pacific Economic Cooperation (APEC) trade group met on Maui to discuss the economic impact of renewable energy technologies. But our islands' role in the further development of renewables goes well beyond providing a pleasant place for meetings on the subject.

For instance, Hawaii is recognized in a report from the Asia Alternative Energy Unit of the World Bank released last December as one of the largest users of solar photovoltaics (PVs) in the world. The report, *Solar Photovoltaics: Best Practices for Household Electrification*, estimates that between 2,000 and 5,000 homes on the Big Island are currently using PV technology to convert sunlight directly into electricity for household use.

Hawaii is helping to accumulate a substantial amount of local knowledge on the practical and day-to-day applications of residential PV systems – knowledge that can be applied globally in implementing similar systems. Notwithstanding MECO's objections to investing in "technology that's not proven," the practical usage and viability of this very technology is being "proven" every day right here at home.

Meanwhile, other electric utilities around the country are taking a closer look at renewable energy. In Detroit - a city not particularly well known for its sunshine - company officials at the local utility are betting that the time is right to offer a cleaner source of electricity to both commercial and residential customers.

Since August 2, residential customers of Detroit Edison have been given the option to sign up for a two year "SolarCurrents" program at an average additional cost of $7 per month. Less than a month after it was introduced, more than 400 residential customers had signed up for the program. The consensus among them seemed to be that the incentives of protecting the environment and improving the economy were worth an extra $7 each month.

Given the greater solar resources available on Maui, a program of this type could be applied here on a much larger scale. Rather than spending an estimated $150 million constructing its new oil-fired power plant as currently planned, MECO could conceivably equip more than 10,000 Maui homes with photovoltaic systems – nearly 25 percent of MECO's residential customer base. The implementation of such an energy strategy could benefit Maui by:

- Freeing up substantial power generating capacity at MECO's current plants
- Moving Maui well down the road toward energy independence
- Developing a substantial local market which could support a PV industry here
- Creating an estimated 700 new jobs
- Providing a much needed boost to the international solar power industry as well as establishing Maui as a new center for innovative us of PV technology

PM

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Exhibit No. 6D

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Pacific Monitor VIA FAX

WORLD NEWS • LOCAL IMPACT

JULY 22, 1996

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p.4 First Hawaiian's Northwest Expansion Continues

Editors

Ian Hodges & Shay Chan

News Desk: 573-2743

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Does MECO Protest Just a Bit Too Much?

This Wednesday (7/24/96), the Hawaii Public Utilities Commission will be holding a public hearing relating Maui Electric Co. (MECO)'s application for approval of a general rate increase of $18,901,900. If approved, this would translate to a 15.1% increase to Maui's residential electric bills.

Just last week, MECO's parent company, Hawaii Electric Industries reported a 13% increase in profits for its electric utility subsidiaries.

The *Pacific Monitor* has been reporting on MECO's energy strategies since last year. In December, we ran a 4-part series called, "Who will Power Hawaii's Future?" and on May 27 of this year, we published "Why is Maui So Expensive to Power?"

In a letter dated May 30, MECO President Tom Jezierny informed *PM* that the articles contained "errors, lack of accuracy, and a lack of completeness."

While Jezierny objected to approximately nine different statements or implications in our series, there was much of interest that he did not address in his letter.

The following are excerpts from our response to Jezierny written on July 10, 1996. To access the full text of his letters and our response (a total 8 pages), enter ◉ **4016**

Before we respond to your specific thoughts on [the 5/27/96] article, we would like to address your criticisms regarding the "incompleteness" of our story... We certainly have never intentionally tried to misinform our readers by purposely leaving out valuable information. If you feel that we have done that, we apologize. Please note that as journalists, it is our job to investigate and question events and situations that impact our community. We take that job very seriously. If, in investigating MECO's request that hard-working Maui citizens pay even more for basic necessities,

cont'd., p.2

Washington Post: Gridlock is Threatening to Spoil Paradise

An article appeared in the *Washington Post* earlier this month entitled, Residents Know, Tourists Are Learning: Honolulu Is Noted for Its Jams.

The *Post* article noted that: "The tourist brochures don't mention it, but at certain times of day Oahu has traffic jams resembling those in many crowded mainland cities. The causes include steady population growth, an aging system of roadways with little room to expand and the location of the island's more affordable housing, a clogged freeway's drive from the sole urban center, where most of the jobs are."

Tour bus driver Daniel Cullen is quoted in the *Post* saying, "The tourists' expectation is blue skies and everybody on the beach, laid back. They don't see traffic on postcards from Hawaii. And their question is: `Where do all these cars come from?'"

Cullen also estimates in the article that he spends 90 percent of his driving time fighting traffic.

Maui is beginning to have serious traffic problems of its own. These need to addressed before we also develop a reputation for snarls.

Special Announcement:

It's Official: Pacific Monitor Editor Ian Chan Hodges is filing this week to run for State Senate

Pacific Monitor Editor Ian Chan Hodges is running for the 5th District State Senate seat. In anticipation of a busy campaign schedule, the *Pacific Monitor* will be cutting back on the frequency of its issues by 50 percent until the Primary Election — September 21.

In addition, the *Pacific Monitor* will avoid publishing any articles directly related to this particular campaign.

Exhibit No. 6E

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Hawaii Stock Market Report

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cont'd. from p.1

we would prefer to err on the side of the citizens' interests than the utility's. (We also understand that it is your job to represent the best interests of the utility, and you are therefore likely to find objectionable any information that might shed a negative light on your company.)

That said:

1. You object to the fact that while we mentioned MECO's 1996 initial rate request [in the 5/27/96article], we neglected to state "that [MECO's] 1996 initial rate request of 19.2% was later reduced by [MECO] (to 3.8%) and the actual [amount] awarded thus far by the Public Utilities Commission [is] (2.8%)."

You are correct that we did not mention that you did not receive the increase. Neither did we state nor imply that you did receive the increase. As a matter of fact, in the fourth paragraph of the article, we state "And now, with the generators delayed, MECO is once again asking for the Ma`alaea increase, this time amounting to a 13% rate hike in 1997." That statement was meant to convey that MECO did not receive the original request, and was now returning to the PUC to request an increase for the Ma`alaea project.

Your statement that the 19.2% increase was reduced by MECO to 3.8% appears somewhat disingenuous. In November articles in the *Maui News* and the *Honolulu Star Bulletin*, consumer advocate Charles Totto strongly recommended against a rate hike. And according to the Chief Auditor in the Consumer Advocate's Office, during the progress of the rate case, MECO determined that they could not complete the Ma`alaea Unit 17 generator in 1996, which meant that the PUC would not allow MECO to recover the costs of that unit in 1996.

So, while MECO may have reduced its request voluntarily, that decision was undoubtedly in response to the fact that MECO knew such a high rate increase could not be granted.

Additionally, since MECO filed an application on May 22, 1996 with the PUC for a 13% average rate increase (and a 15% residential rate increase) -- barely 3 months after the 2.8% was granted -- your implication that MECO is not interested in greatly increasing its rates is difficult to accept. If MECO does receive the 15% increase, in 1997, Maui residents will be paying 17.8% more for electricity than they did in January, 1996.

2. You state that we "misinterpret the information discussed at the public meetings. The 232 MW that can meet Maui's future needs is not a single generator but would consist of 12 separate generators, to be installed in phases."

While you are correct that we incorrectly described the hardware involved in the new power plant planned for "2004 and beyond," we did not err when we stated that the 232 MW planned for the generators "would provide enough energy to power an additional 50,000 homes on Maui. Since the first generation of the project would cost about $150 million, the cost to power users would be significantly more than what MECO wants them to pay for a $20 million generator at Ma`alaea." We were trying to make a point about the amount of power the new plant would provide and how much it would cost. We apologize for describing the mechanics of the plant incorrectly...

You note that hydropower has not been successful on Maui. We mentioned hydropower as one of the possible sources of alternative energy. You are probably correct that hydropower would not be the best source of alternative energy for Maui. Other sources, however, of alternative energy include wind, biomass, and solar power. As we noted in the December 18, 1995 Pacific Monitor article "Is Renewable Power in Maui's Future?": "Rather than spend ing $150 million constructing its new oil-fired power plant as currently planned, MECO could conceivably equip more than 10,000 Maui homes with photvoltaic systems – nearly 25% of MECO's residential customer base." We then explained that such a move could "free up ...power generating capacity at MECO's current plants, move Maui ...toward energy independence, develop a substantial local market which could support a PV industry here, create an estimated 700 new jobs, and provide a...boost to the international solar power industry as well as establish Maui as a new center for innovative use of PV technology."

6. You note that we state that "If the company can provide power at a cheaper

cont'd., p.3

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Requests for Proposals issued by the State of Hawaii May 22-24.

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Who Will Power Hawaii's Future?

The Pacific Monitor Four-Part Series from November & December 1995. Get the Full Story.

◉ 4015

Why is Maui So Expensive to Power?

In November and December of last year, *Pacific Monitor* published "Who will Power Hawaii's Future?" a four-part series on the provision and distribution of electricity in Hawaii. In the first two articles, we looked at the rising costs of electricity on Maui, and the impact of those expenses on small businesses and public services. (Just a month before, Hawaii schools had announced that they would be unable to pay their electric bills.)

At the time, Maui Electric Co. (MECO) was requesting a 19.2% rate increase, which would raise residential bills by about $15 per month. MECO defended the increase as necessary for the recovery of $20 million in equipment costs for a hotly-disputed generator at Maalaea. Consumer Advocate Charles Totto had characterized the increase as unjustifiable because the generator, which would not be completed in 1996, could not be charged for until it was in use.

Pacific Monitor noted in Part II of the power series that while MECO was trying to raise rates to pay for one generator, it had already had numerous meetings with the public and public officials about its upcoming plans to build a much larger 232 MW generator -- to meet power needs thirty years from now. The generator MECO has in mind would provide enough energy to power an additional 50,000 homes on Maui. Since the first generation of the project will cost about $150 million, the cost of this project to rate-payers will be significantly more than the $20 million generator at Maalaea.

And now, with the Maalaea generator delayed, MECO is once again asking for an increase for that project – this time amounting to a 15% residential rate hike in 1997.

It is important to remember that if this rate hike is finally approved, residents will not just pay another $13 per month or an additional $156 per year. They will also bear the indirect costs that result from the increased expense of operating businesses on Maui, as well as additional County and State expenses due to higher electric bills. The County's electric bill alone will increase by over $1 million.

And MECO already has some of the highest rates in the country (see table). Interestingly, because of investments in alternative energy, electric rates are dropping significantly in other parts of the country. For example, Seattle City Light, a municipality-owned electric company, and Puget Sound Power & Light Company, the state's largest privately owned electric utility both provide hydro-electric power at far less than the national average rates.

	Selected U.S. Cities	Residential 1000 kWh
Comparison of Monthly Electric Costs In Selected U.S. Cities (January, 1994)	Boston	$118.96
	Chicago	88.69
	Denver	74.44
	Los Angeles	98.93
	San Francisco	133.15
	Portland OR	53.81
	Seattle: City Light	48.10
	Puget Power	58.33
	(May,1996) Maui	144.34
	(after 15% increase) Maui	165.99

* In monthly costs, by Kilowatt Hour
Source: Seattle City Light & MECO

MECO's sister on the Big Island, Hawaii Electric Co. (HECO), also owned by Hawaiian Electric Industries (HEI), may soon be forced to follow Wasthington State's lead. Amoco/Enron Solar Power Development has proposed a $7-million 4-MW solar electric facility there. If the company can provide power at a cheaper rate, by law, HECO will have to purchase that company's electricity and pass the savings on to customers.

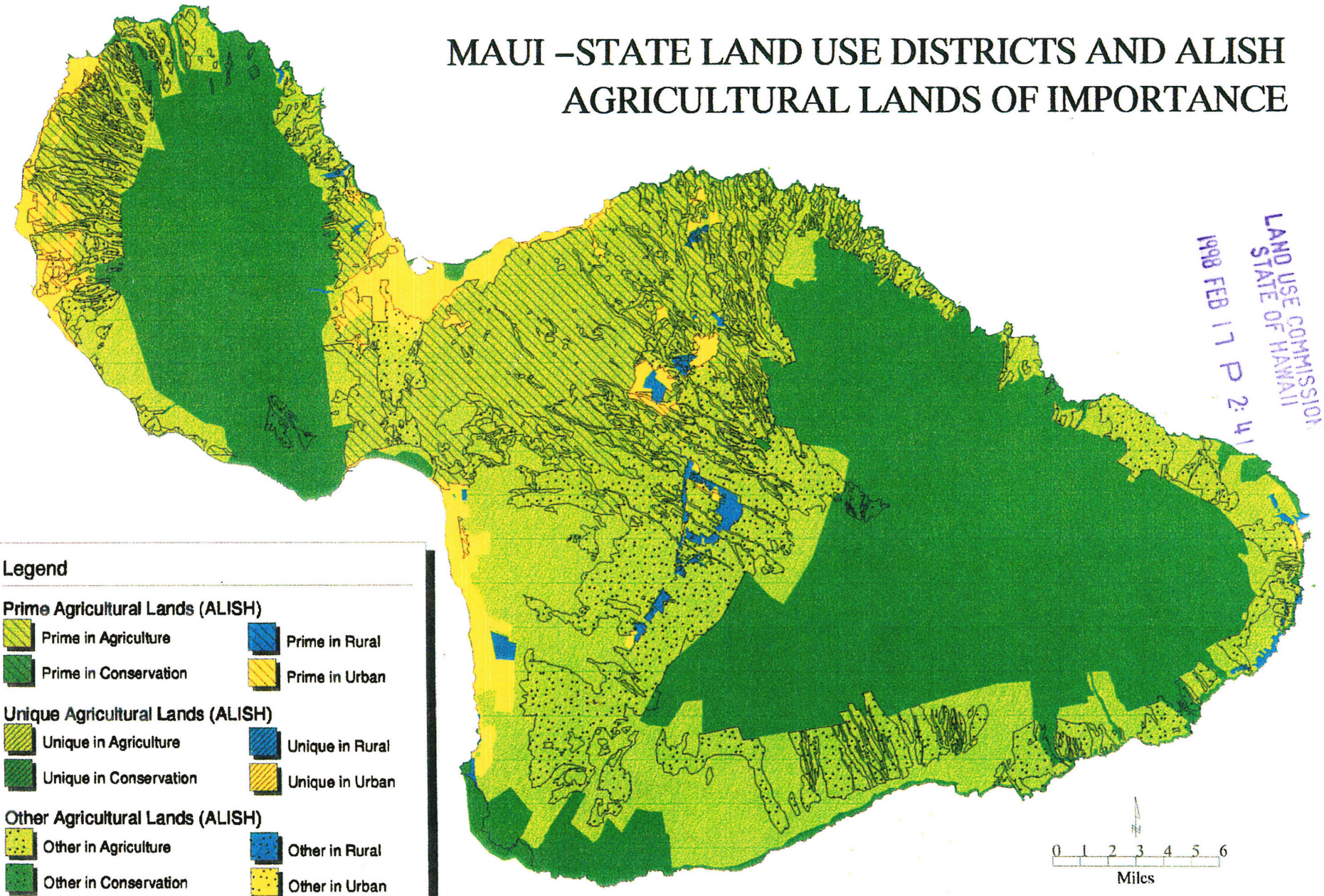
In the meantime,because the utility is guaranteed a 11% profit margin, the more energy costs, the more HEI makes. HEI has little motivation to find cheaper methods of delivering power to customers, and a very clear motivation for looking for new ways to spend money. In 1994, HEI profits hit a new high, only to be surpassed in 1995, with a 9.4% increase already shown in the first quarter of 1996.

PM

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Exhibit No. 6F

MAUI –STATE LAND USE DISTRICTS AND ALISH AGRICULTURAL LANDS OF IMPORTANCE



Produced for County of Maui by Geographic Decision Systems International (GDSI)

29 Jul 1996

LAND USE COMMISSION
STATE OF HAWAII
1998 FEB 17 P 2:41

Exhibit No. 1

Estimated Acreage of Land Use Districts, by Islands, January 1995

Source: Hawaii State Department of Business, Economic Development & Tourism, Land Use Commission, records; per the Maui County Data Book, 1995.

Island	Total Area	Urban	Conserva-tion	Agricultural	Rural
Maui	465,800	20,640	193,631	247,770	3,759
Lanai	90,500	3,228	38,197	46,678	2,397
Molokai	165,800	2,509	49,768	111,657	1,866

Island	Total Area	Urban	Conserva-tion	Agricultural	Rural
Maui	100%	4.5%	41.7%	53.0%	0.8%
Lanai	100%	3.6%	42.2%	51.6%	2.6%
Molokai	100%	1.5%	30.0%	67.4%	1.1%

ALISH CLASSIFICATIONS
ISLAND OF MAUI

	PRIME	UNIQUE	OTHER	TOTAL ALISH	STATE AG DISTRICT TOTAL	NON-ALISH STATE AG DISTRICT
ACREAGE	67,912	166	81,010	149,088	247,770	98,682
% OF ALISH	46	0	54	100		
% OF STATE AGRICULTURE DISTRICT	27	0	33	60	100	40

g:sluc.tbl(6/24/96)

Excerpts from the Jan. 11, 1998 Honolulu Advertiser article by Frank Cho:

[HEI Executive Vice President Paul] Oyer said environmental concerns are making it increasingly difficult to find new locations for power plants to meet Hawaii growing electricity needs, thereby driving up costs for consumers.

Maui Electric is planning to complete a new power plant on Maui in late 1998 - a facility it hopes consumers will pay for with new, higher rates.

"Its very hard to absorb the investment in a new plant. That's why we have had to seek rate relief," Oyer said.

(Full article will be provided at Feb. 26 hearing)

Exhibit No. 8

HOFA

HAWAII ORGANIC FARMERS ASSOCIATION
P. O. Box 984 , Haiku, Hawaii 96708 (808) 573-0995 (Phone & FAX)
http://ddi.digital.net/~planet/hofa.html e-mail: hofa@aloha.net

21 January 98

Maui Tomorrow
Board of Directors
Makawao, HI 96768

Dear Gentle persons:

This comes as a letter of support being in opposition to the projected power plant which Maui Electric Company is proposing to build in the Lower Kula area of Maui. As an agricultural organization, Hawaii Organic Farmers Association views the project as detrimental to any farming operation which would ever be subject to the inevitable and consistent toxic plume emanating from such a plant.

Growing food requires clean air, as well as clean soil and water; in fact air is the principle component in the growth of a plant. To compromise the source of plant growth is unwise. Moreover, as Kula is the primary site of agriculture on Maui, to build such a facility as an electrical generating plant anywhere near this vicinity would impact the agricultural community disproportionately and is surely not in the best interests of farmers or consumers.

The demands for more power for the future of Maui need to be seriously addressed through conservation on the demand side and alternative sources, such as solar, on the supply side. Let us not further risk our fragile ecosystem or our tenuous farming economy by this unwise development.

Sincerely,

Diana Dahl

Diana Dahl, for HOFA Board of Directors

Exhibit No. 9

P. O. Box 984 *Haiku, Hawaii* *573-0995*

27 January 98

William A. Bonnet, President
Maui Electric Company, Ltd.
P. O. Box 398
Kahului, HI 96733-6898

RE: Response to Draft - Environmental Impact Statement
Waena Generating Station

Dear Mr. Bonnet:

Following is testimony which I am submitting on the proposed Waena Generating Station for your information and attention. As a farmer and as a member of the Board of Directors of Hawaii Organic Farmers Association, I am addressing clean air issues relating to the impact of the Waena Plant on agriculture.

If built, the Weana Generating Station would release into the heart of Maui's prime agricultural lands, according to the Draft, 637,811 tons of proven toxic material in the thirty years following construction. Included in this emission is 19,000 pounds of lead, fifty-two pounds of beryllium, and one hundred eighty pounds of mercury. These metals do not bio-degrade to less toxic forms. In fact mercury forms the much more toxic mono- and di-methyl mercury in the environment as a result of chemical and biological processes. Surely any device which would produce this much cumulative damage should be regulated as *aweapon of mass destruction*. A combustion-based energy system belching poison onto Maui's farm lands is foolhearty, certainly unsustainable, and will be a cause of longterm health problems.

Given the current development in photovoltaic energy systems, several systems already compete on the basis of installed system price, as well as promise zero local emissions. One is *customer-sited photovoltaics(CSPV)*. An analysis by National Renewable Energy Laboratory (NREL) shows Maui enjoys a $7.00 break-even price per watt, the Big Island $8.40 per watt, Kauai $9.70 per watt, and Oahu $6.40 per watt. This means panels at $7.00 per watt can replace diesel generators at no additional cost and would produce more installation jobs with better pay than trucking fuel. Furthermore, the cost of solar photovoltaic panels is decreasing, while quality and volume of products are increasing, resulting in further savings over time. As we know, diesel fuel prices will continue to increase over time.

In summary, the Weana Generating Station as proposed does a great disservice to future generations with its inescapable toxic emissions resulting in the needless destruction of prime farm land and water resources. Having read the EIS Draft, I am willing to dialog in depth on the impacts of the emissions which are projected in the document. I look forward to your reply.

Sincerely,

Exhibit No. 10

BYLAWS OF MAUI TOMORROW FOUNDATION, INC. (1996 revision)

Article I: Name, Purpose and Seal

1.01 Name

The name of the corporation is *Maui Tomorrow Foundation, Inc.*

1.02 Purpose

The purpose of the corporation is to advance the protection of the island of Maui's precious natural areas and prime open space for recreational use and esthetic value, to promote the concept of ecologically sound development, to preserve the opportunity for a rural lifestyle on Maui, to promote, sponsor and participate in educational and community programs, seminars and other functions related to the foregoing purposes, and to carry out litigation as necessary to advance the foregoing purposes.

1.03 Non-profit

The corporation is organized exclusively for charitable and educational purposes, under section 501(c)(3) of the Internal Revenue Code.

1.04 Non-Discrimination

There shall be no discrimination on the basis of race, color, religion, sex, national origin, marital status, age, or handicap with regard to hiring, assignment, promotion, or other conditions of staff employment, use of volunteers, or services.

1.05 Corporate Seal

The corporation shall have no seal.

Article II: Board of Directors

2.01 Board of Directors

The property and affairs of the corporation shall be managed by a Board of Directors consisting of at least three and no more than fifteen members. The Board of Directors shall exercise all lawful authority for that purpose. All members of the Board of Directors shall be residents of the County of Maui, State of Hawaii.

Exhibit No. 11

2.02 Meetings

The Board of Directors shall have an annual meeting in the County of Maui, Hawaii, on the second Tuesday of January of each year (or at a place and on a date proximate thereto, as selected by the prior agreement of the Board of Directors), and may have additional meetings at such other times and places as appropriate. If necessary, any meeting of the Board of Directors may be held by a telephone conference. The Board of Directors may take any necessary vote by telephone poll conducted with the approval of the President; an affirmative vote by a majority of the Board of Directors shall be required to approve any item by telephone poll.

2.03 Quorum

A majority of the active members of the Board of Directors shall constitute a quorum. A member of the Board of Directors shall be considered inactive beginning on the third consecutive meeting of the Board at which the member is absent, and shall remain inactive until the member again attends a Board meeting. In all matters, the members of the Board of Directors shall strive to obtain a unanimous consensus, but, lacking a consensus, a majority of the directors present at any meeting where there is a quorum shall rule.

2.04 Election

New directors will be elected by their predecessor members of the Board of Directors at the last regular Board meeting of the year or at any other time proximate thereto selected by the Board. The terms of new directors shall begin on January 1st of the following year. Directors may succeed themselves in office. The Board shall endeavor to elect the next year's Board at the last meeting of the year, but in case the Board fails to do so, the same directors shall continue to serve until the Board conducts a meeting to determine whether they shall begin a new two-year term or not.

2.05 Term

Each Director shall be elected for a term of two years. Any Director may be removed from the Board by a two-thirds vote of the full Board of Directors.

2.06 Vacancies

The remaining member or members of the Board of Directors may at any time designate new directors to fill any existing vacancies on the Board of Directors.

By agreement of a majority of the Board members present at any meeting, the Board may designate any other Board member aside from the President to preside over a meeting.

3.03 Vice-President

The Vice-President of the corporation will preside over any meeting of the Board of Directors from which the President is absent and fulfill any and all duties of the President in case the President is disabled from doing so for any reason, and shall fulfill such other duties and responsibilities as shall be designated by policies established by the Board.

3.04 Secretary

The Secretary will keep minutes of all meetings of the Board of Directors and shall maintain the general records of the corporation and undertake such acts as may be necessary to keep the corporation in good standing in the State of Hawaii. The Secretary shall have the power to sign contracts, notes, minutes of meetings, and all other instruments approved by the Board of Directors.

3.05 Treasurer

The Treasurer will keep the financial books and records of the corporation, and report upon same to the Board of Directors at least annually. The Treasurer shall make all books and records of the corporation available to any other Director upon request.

Article IV: Members and Committees

4.01 Members

The corporation shall have no members.

4.02 Committees

The Board of Directors may establish by resolution any standing or special committees that may be deemed necessary in the exercise of their discretion.

4.04 Advisory Board

There shall be established an Advisory Board, whose members shall be chosen by the Board of Directors. The Advisory Board shall not have any formal decisionmaking power, but shall advise and serve as a resource for the corporation.

Article VI: Indemnification

5.01 Generally

The corporation shall indemnify the members of the Board of Directors, all corporate committees, and corporate agents and employees to the full extent allowed by laws governing nonprofit corporations in the State of Hawaii.

5.02 Bonds and Insurance

The Board of Directors may obtain such bonds and insurance as may be deemed appropriate in its discretion to accomplish indemnification and related purposes.

Article VII: Miscellaneous Matters

6.01 Fiscal Year

The fiscal year of the corporation shall be the annual year. The Board of Directors shall be empowered to determine an alternative fiscal year by resolution.

6.02 Amendments

The Articles of Incorporation and these Bylaws may be amended only as follows:
(a) an amendment to the Bylaws may be proposed at any time by the Executive Director or any member of the Board of Directors;
(b) at least seven days prior to the Board meeting at which the amendment is to be considered, a copy of the proposed amendment shall be delivered to each director, provided that no copy need be delivered to any director who is off island in the seven days preceding the meeting and on the day of the meeting, and provided further that no advance notice need be given of Bylaw Amendments proposed at the annual meeting..
(c) any director may vote on the amendment by proxy if unable to attend the meeting;
(d) at the designated meeting, after due deliberation, the proposed amendment shall be adopted by majority vote of the active members of the Board of Directors.

Amendment of the Articles of Incorporation and Bylaws shall be further subject to the requirements of chapter 415B of the Hawaii Revised Statutes and any other laws governing nonprofit corporations in the State of Hawaii.

Dissolution of the corporation may be accomplished as provided by the laws governing nonprofit corporations in the State of Hawaii, as limited by the Articles of Incorporation.

Certification

I hereby certify that the foregoing Bylaws of the *Maui Tomorrow Foundation, Inc.*, were duly adopted by the Board of Directors at their meeting held on the 18th day of January, 1996

DATED: 4/5/96, Maui, Hawaii, April 5, 1996

Richard Joseph Lafond Jr.
Executive Director

MAUI TOMORROW CONTRIBUTORS - KIHEI - page 1

Haleakala Shores Homeowners Assn., PO Box 1079

Boyle Construction Co., 2480 S. Kihei Rd., D-2

Elvin K. Wilson Family Trust, 2480 S. Kihei Rd.

Hale Pau Hana Association, PO Box 1079

Lytescary Holdings, Ltd., 2480 S. Kihei Rd, #701

Graham-Con & Assoc., PO Box 1674

Maui Classic Charters, 1215 S. Kihei Road

Local Motion, 1819 S. Kihei Rd.

Maui Tropics, P O Box 1113

Chuck's Steakhouse, 1881 S. Kihei Road

Mercury, PO Box 277-103

T-Yemeni, PO Box 277, Ste. 220

Hildegard Abramson, 1299 Ulunui Rd., B-201

Eros & Alex Alexander, PO Box 1535

Lee Altenberg, 2605 Lioholo Pl.

Judy Anderson & Kevin Fleming, 2788 Kauhale St.

Aileen Armstrong & Roy Strutt, 2480 S. Kihei Rd. #14

Gregory & Judith Arnett, 3424 Keha Dr.

Michael Bailey, PO Box 277-239

Tonia & Steven Baney, 1627 S. Alanui Pl.

Kenneth & Kathy Barr, Maui County Planning Commissioner, PO Box 1637

Alan & Diane Beaurline Wine & Spirits, 564B Kumulani Dr

Bruce Bebe, Waipuna Assoc. Environmental Consultants, PO Box 959

Dennis Bell, Hawaiian Classic Perfumes Inc., P O Box 2184

Edward & Ethel Belway, PO Box 1581

Rollene & Geoffrey Billings, 167 Mahina St.

Exhibit No. 12

MAUI TOMORROW CONTRIBUTORS - KIHEI - page 2

Rena Blumberg, Greenpeace Hawai'i, 553 Mikioi Pl.

William & Theresa Boland, 760 S. Kihei Rd., #625

Howard & Nancy Boone, 2480 S Kihei Rd

Betsy Bowen, Ke Ala Hoku, PO Box 959

Susan Bradford & Gordy Lange, PO Box 2302

Susan Brater, 53 Hoawa'a Way

Carol Burdick, 1484 Halama St

Margaret Burke, 539 Kupulau Dr.

Hilda Burrier, PO Box 881

Finil Caaen, 80 Hale Hookipa Way

Terry Clarke, PO Box 1438

John Connelly & Dennis Thibeault, 723 Kupulau St.

Sunny Crowley, Kizmet Brokerage, 550 Kupulau Dr. #A

Eric Cuomo, 41 Keala Pl.

Constance Cushman, 2480 S Kihei Rd, #207

Gordon Davenport, PO Box 27

Daryl Davis, 15 Koki St.

Toni, Mark & Ashley Davis, Pride of Maui Charters, 208 Kenolio Rd.

Kaywin Dean, 1183 Lauli Place

Margot Denman & Jane Houston, 2480 S Kihei Rd, #402

Ivan Dixon, KONI-FM, 300 Ohukai Rd., #318

Ruth & Robert Dodson, 811 S. Kihei Rd., #4A

Susan Douglas, 3145-A Makamae Pl.

Karen Downard, 959 Kupulau Dr

Marc Drehsen, PO Box 826

MAUI TOMORROW CONTRIBUTORS - KIHEI - page 3

Laureen Elizabeth, 2129 S. Kihei Rd. #1403

Janie & Ray Ennis, Stella Blues Cafe & Deli, 1215 S. Kihei Rd., Unit Q

Mr. Evans, 348031 B.C. Ltd. dba Hale Pau Hana Penthouse, 2480 S Kihei Rd

Lucy Feinberg, 483 S Kihei Rd

Clara Felix, 255 Olani Pl.

Helen Felsing 2000, 2846A Puuhoolai St

Carla Flood, Kihei Comm. Assoc. / Kihei 2000, PO Box 662

Ralph Fullerton, 3111 Waiea Pl.

Gordon & Marlene Gahagan, 272 Hapakolu Pl

Kathleen Gildred, S. CA Council on Envt & Devt, 3378 Keha Dr.

Kenyavani Gillman, PO Box 733

W.R. & Audrey Gilroy, 86 Makena Rd.

Brighid Godtfredsen, 3356 Kehala

Steve Goodfellow, Goodfellow Bros. Inc. Gen. Contractors, 381 Huku Lii Pl., Ste. 202

Alan Goodwin, 160 Keonekai Rd., Apt. 7-103

Shirley Grant, 2480 S Kihei Rd, #305

Paul & Anita Greenman Akahi, 2531 S. Kihei Rd. D-402

Gabriel & Lois Greenwood-Audant, 3495 Malina Pl.

Jason & Mary Groode, PO Box 1551

Kevin Harrington, Harrington Productions, PO Box 1179

Daniel Harris, 140 Uwapo Rd, Apt 60-201

Adele Hartzell, 22 Hoawa'a Way

John & Louise Heydorff, 2480 S. Kihei Rd., #103

Robert Hill, 2881 S. Kihei Rd. #L-130

Alan & Peggy Hoffman, 187 Aha'aina Way

Walter & Lilo Holmstrom, 2480 S. Kihei Rd., #404

MAUI TOMORROW CONTRIBUTORS - KIHEI - page 4

Pat Howle, 80 Waikai St.

Paul Hugel, No Ka Oi Foundation, 515 S. Kihei Rd.

Howie J. Eintracht, Howie From Maui, PO Box 1781

Buck Joiner, 3443 Malina Pl.

David & Roberta Jones, 3343 Kuaua Place

Meagan Jones & Anne Rillero, Pacific Whale Foundation, 101 N. Kihei Rd., Ste. 21

Annie Kemper, 1539 Halama Street

Edward V. Ketcham Jr., 2994 S Kihei Rd., #306

Alicia Bay Laurel, A Wedding Made In Paradise, PO Box 986

Romy Leah, 1074 Kupulau Dr. #A

Mirayam Licht, 3515 Hookipa Pl

Jean Lierly, 339 Kaiwahine St

Rudy Boogie & Violet Lu'uwai, 5100 Makena Road, Makena

Joan Maksut, R.A. Trimble Realty, 2640 Kanakanui Rd.

Ronald & Eileen Maniaci, PO Box 1929

Stephen & Lottie May, 2480 S. Kihei Rd.

Zhidre & Ivon Mazza, 126 Mehani Pl.

Mike & Hella McCormick, 3445 Keha Dr.

Donnie McGean, HawaiianMoons Natural Foods, 2411 S. Kihei Road

Patricia McManus & Fred Foss, 2531 S. Kihei Rd., D-106

William & Billee Morgan, 2480 S Kihei Rd, #403

Jean & John Morrissey, 2430 S. Kihei Rd. #611

Patrick Nash, 555 Pawali St

William Neumann, 299 Keonekai Rd.

Alice Nutt, 2480 S Kihei Rd, #507

MAUI TOMORROW CONTRIBUTORS - KIHEI - page 5

Kachina Palencia, 3091 Mapu Pl.

Hans & Marilyn Peters, 2619 S. Kihei Rd.

Bard Peterson, Tradewind Kayaks Maui, 3505 Akala Dr.

Virgil & Jane Peterson, 2737 S Kihei Rd #201

Anne Pierce, 3309 Keha Dr.

Nancy Plenty, 2058 Kanoe St., #2A

Jean Prandini, 2619 S Kihei Rd, B511

Manon & Shinzo Pretre, PO Box 65

Heather Proud, 31 W. Waipuilani Rd.

Jenny Reading, P.O. Box 959 #0-705

Tom Reed, 3548 Lanihou Pl.

Paul & Aileen Reioux, 613 Luana Pl.

Lloyd Riford, 3145 Nahenahe Pl

George Rixey & Randy Wagner, Artel, Inc., 187 Heleuma Pl.

Judy Roebeck, 1993 S. Kihei Rd #400

Dan Rogers, 45 Kahele St

Mark Rooney, Kamalii Elem School Playground Project, 250 Hale Kai Street

Justin Russell, 7070 Makena Rd.

Rebecca Russell, 823 Malulani St.

Lori Sablas, Kaanapali Beach Hotel, 151 Kupuna St

Kathleen Schulz, 2722 Kauhale St

Bob Schwartz, 288 Kaiwahine St.

Marian Scott, 45 Kahele St.

R.W. Scott, 2480 S Kihei Rd

Diane Shepherd, 3329 Kehala Dr

Lila Sherman, The Love Shack, PO Box 1817

MAUI TOMORROW CONTRIBUTORS - KIHEI - page 6

Donna Smith, 2050 Kanoe St. #104

Dorothy, Gary & Rick Smith, The Waterfront, 114 Mehani Pl.

Tina Sohn, Sunsource Health Prod. / Sohn Foundation, 535 Lipoa Pkwy., Ste. 110

Karen & Ken Stover, All Computer Services / Hale Alana Vacation Rental, PO Box 160

Pauline Sugarman, 964 Kupulau Dr.

Robert & Marilyn Teitelbaum, Shalom Realty, 38 Kamakoi Pl.

Kathy Theron & Jennifer Hamada, PO Box 68

Gene Thompson & Jack Esker, Maui Outdoor Circle, 2531 S. Kihei Rd., C-502

LiLi Townsend, 1046 Kupulau Dr.

Adrianna Tripolt, Maui Colon Health Center, 1993 S. Kihei Rd., Ste. 211B

Mike Trotto, 125 Alahele Pl.

John & Natalie Tyler, Ctr. for Psychotherapy & PAIRS Training, 3270 Kehala Dr.

Lothar & Irmgard Ullmann, 1574 N Alaniu Pl.

Harriet & Tony Van Steen, Brown Enterprises, 3261 Mapu Place

Susan Wadsworth, 3210 Lanina Place

Madge Walls, MTW enterprises, 2124 Awihi Place #314

Myia Wannemiller, 258 Hoalike St.

Merrily & Charlie Webb, 3134 Hoomua Dr.

Charles & Diane Weidner, 2619 S. Kihei Road, A411

Libra Weltsch, PO Box 329

Will & Tashina Wilkinson, From the Heart, 3134 Nahenahe Pl.

Steven Williams, 537 Kumulani Dr.

David Wilson, Maui Group - Sierra Club, 609 Kaiola St

Robbie Wilson, Robbie Wilson Salon, 606 Luana Pl.

Diane Zachary, Maui Pacific Center, 590 Lipoa Pkwy

MAUI TOMORROW CONTRIBUTORS - KIHEI - page 7

Robert & Harriet Zant, Hale Pau Hana, 480 S. Kihei Rd

Cheryl & Gene Zarro, 27 Nohokai St.

MAUI TOMORROW CONTRIBUTORS - WAILEA

Ham & Nancy Harris, 4000 Wailea Alanui #1101

Mike Johnston, Chart House, 100 Wailea Ike Dr.

Patrick Michaud, 139 Waaula Pl.

Peter O'Connor, Grand Wailea Resort, 3850 Wailea Alanui

Laura Rosenthal & Sudha Scott Massage & Body Care, 3550 Alanui Dr.

Thomas & Katherine Smith, 10 Wailea Ekolu Pl., #904

Kathy Van Vechten, Four Seasons Resort, 3900 Wailea Alanui

MAUI TOMORROW CONTRIBUTORS - WAILEA

MAUI TOMORROW CONTRIBUTORS - PUKALANI

Lou Ann Barcai, 360 Hokulani St

Eve-Lynn Civerolo, 2667 Iolani St.

Tanee Connally, 2765 Iolani St

Raj Cook, PO Box 103

Julie Higa, 187 Alohi Pl

Edith Ichiriu, PO Box 213

Victoria Joyce, Greg Lagoy & Tim O'Hara, Musical Options, 50 Poha Pl.

Olive Karony, 65 Nanaina

Mark & Mary Ellen MacKay, 306 Haulani St.

Lorrie & Brian Miller, Rainbow Jo's, 3423 Anuwanu Pl.

Rick Perrie, 81-25 Makawao Ave

Fernando Ribao Jr., 26 Alohi Pl.

Anna Mae Shishido, Maui Group - Sierra Club, 55 Haaheo Place

David & Rose Yanagihara, Courage & Love Rehab. Svcs., 398 Ali'iolani St.

MAUI TOMORROW CONTRIBUTORS - KULA - page 1

Haleakala Waldorf School, R.R. 2, Box 790

Andrew Annenberg, Annenberg Masterworks, PO Box 778

Bren & Fred Bailey, Makani Ltd., RR2 Box 126

Lenore Bearman, 214A Holomakani Dr

Mitch & Joan Berman, SR 50

Richard Betz, PO Box 1203

John Blair, RR 1, Box 479B

Phillip & Tanesha Bonde, 157 Holopuni Rd.

Don & Judy Brown, RR 2, Box 116

Alana Lynn Bryan, PO Box 632

Cynthia Burke, Courtyard Deli, RR 1 Box 485

Carol Childerhouse & Dudley Smith, RR 2 Box 256

John Cho, P O Box 301

Greg & JoAnn Chou, 209 Kawchi Place

Azby Chouteau & Kari McCarthy, RR1, Box 464

Diane Clarke & Heinz Rominger, Cybernauts, 108 Kulalani Dr.

David & Kathy Coakley & Sons, RR1, Box 297C

Robert Coffey, PO Box 391

Bob Colopy, PO Box 586

Hunton & Radha Conrad, PO Box 653

Curtis Wilson Cost, PO Box 90

Mr. & Mrs. R. Dougal Crowe, RR 2, Box 96-A

John & Mary Cusack, 689C Omaopio Rd.

Martin & Denise Diamond, Island Essence, SR Box 101

Richard Duffy & Ruth Ballinger, 113 Hapapa Rd.

Pat Elf, Winner's Circle Unlimited, RR2, Box 93B

MAUI TOMORROW CONTRIBUTORS - KULA - page 2

Robert & Toni Fahnestock, PO Box 458

Mark Ferguson & Jan Hasse, PO Box 321

Joanne Fitch-Darling, RR2, Box 780

Jamie Fonseca, Chelsea Rose, PO Box 276

Rory Frampton, 253 Holomakani Place

Joel Friedman, M.D., PO Box 606

Virginia Gardner, 234A Holomakani Pl.

Mike Gerry, Silver Cloud Ranch, RR2 Box 201

Kit Gillette, 619 Omaopio Rd

Gayle Gordon, PO Box 234

Pam Gould, Yards & Gardens, RR3 — 115 Kula Hwy.

John & Susan Guard

Paul Guard, PO Box 158

Naomi & Walter Hillinger, SR 100

John & Marilyn Hirashima, Sunrise Protea Farm, 1119 Manu St.

Scott & Dr. Julie Claire Holmes, 651 Omaopio

E.B. Holroyde, 382 Hapapa Road

Deborah Hoopingarner-Diehl, 109 Lopaka Pl.

Harlan Hughes & Judy Anderson, RR1 Box 538

Brian Jenkins, Brumbaugh & Jenkins, 221 Ululani Rd.

Karen & Jim Jones, 523-C Kimo Dr.

Buzzy Kaufman & Gayle Gordon, Focus on Fitness, PO Box 234

Charles & Lenore Knobel, 109-D Kolahala Dr.

Mike Krueger, 1110 AinaKula

Larry & Lori Land, Paradise Pharmacy - Pukalani, RR 2, Box 230

MAUI TOMORROW CONTRIBUTORS - KULA - page 3

Tom , Ann, & Stephanie Leutenecker,

Winifred Marsh, 493 Upper Kimo Dr.

Nick Matichyn, Maui Coffee Roasters, 79 Polipoli Rd.

Dick & Rosily Mayer, RR 1 Box 518

Alyssa Miller, Pacific Environmental Research, RR 1 Box 513

Nina Miro-Quesada, Valley Original, RR4 Box 49

Don Moore, Kula True Value Hardware, PO Box 539

David Morihara, RR2 Box 18

Rev. Heather Mueller-Fitch, St. John's Episcopal Church, RR 2, Box 212

Jim & Laurie Murray Jr. , RR 1, Box 449A

Patty Nakao, RR1 Box 458

Bonnie Newman, 116 Pea Pl.

Jeanette Ostrander, 233 Naalae Rd., #A

Jore Park & Wylee Fables, SeaSeer, PO Box 1213

Bob & Hana Peck, RR4 Box 36

Oliver Perz, Laf Young & Assoc., 106 Holopuni Rd.

Pamela Polland, Off the Leash, 110 Kulalani Dr.

Kevin Puliatch, PO Box 355

Carolyn & Robert Richardson, 106 Poohina Rd

Patricia Rife, PO Box 808

Fred & Patty Rohlfing, RR1 Box 398

Fred Romanchek, Kula Lodge & Restaurant, RR1 Box 475

David Rose, Income Builders International, SR 50

Mark Rudd, PO Box 388

Bob Schmidt, PO Box 1072

Carol Sherrill, RR2 Box 106

MAUI TOMORROW CONTRIBUTORS - KULA - page 4

Mike Singlehurst, PO Box 396

Robert Smith, Hawaiian Outdoor Adventures, 102 16 Kaui Pl.

Allan Sparks, RR 1 Box 522A

Lisa Starr, Ukulele Clothing Co., P O Box 720

Gayle Stevens, 231 Ululani Rd.

Candle Summers, Candlelights Studios, RR2 Box 16, Lwr. Kula Rd.

Roger & River Sussman, PO Box 1255

Steve & Maggie Sutrov, 124 Ainakula Rd

Yuri Imanishi & Brian Swift, PO Box 331

Greg Tiedeman, PO Box 1098

Barry Trofka, Santa Claus, RR2 Box 2588

Barbara Waterhouse, 1112 Mano Dr.

Dr. Gary & Bernadette Wilkins, 210 Puakea Pl.

Joy & Darrell Williams, 433 Crater Rd.

Matthew Winters, RR1 Box 482-A

Emi & David Young, RR 2 Box 262A

RICHARD D. MAYER
RR1 Box 518
Kula, Maui, Hawaii 96790
Business phone:(808) 244-9181
Home Telephone:(808) 878-1874

PRESENT OCCUPATION: Economics/Geography Professor
University of Hawaii: Maui Community College
AGE: 55 (February 12, 1942)
MARITAL STATUS: Married
WIFE: Supervisor: Utilization Review, Maui Memorial Hospital
SOCIAL SECURITY: 015-32-2109

EDUCATION

. B.A. (Economics): Brandeis University, (Waltham, Mass.), 1963
M.A. (International Business/Economic Geography): U. of Washington, 1967
Advanced Work: University of California (Berkeley); University of Hawaii; Bowling Green University

WORK EXPERIENCE (SELECTED)

1963-1965	Peace Corps/Nepal: Community Development
1967 - Present	**Maui Community College, Kahului, Maui, Hawaii, 96732**
(31 Years)	**Title: Professor**
	(Tenured since 1971)
Teaching Areas:	**Principles of Economics, Personal Economics,**
	Personal Money Management, World Regional Geography
1968-1969	Division Chairperson, Liberal Arts Division
1975-1977	Division Chairperson, Social Science/Humanities Division
1970	U. S. Federal Census: Crew Leader
1981	Consultant to VITA: Technical assistance to 3rd world peoples
1984-1985	Consultant: Financial Planning, State Retirement System
1984-1987	Seminar Leader: Personal Money Management; State Retirement System: US Census Data; 1986 Tax Reform Act
1985-PRESENT	Legal: Expert Witness in Economics

COMMITTEE WORK (Within University of Hawaii system)

UNIVERSITY OF HAWAII SYSTEM LEVEL - COMMITTEE WORK

.Hawaii State Open University
.University of Hawaii General Education Core Requirements
UH Environmental Center: Environmental Impact Statement Review
University of Hawaii Academic Affairs Committee
University of Hawaii Strategic Plan Committee

COMMUNITY COLLEGE SYSTEM LEVEL - COMMITTEE WORK

(APPOINTED BY COMMUNITY COLLEGE CHANCELLOR)

Community College Master Plan
"Directions for the 80's" Committee
University Reorganization Committee

MAUI COMMUNITY COLLEGE - COMMITTEE WORK

Curriculum Committee
Budget Committee: Chairperson for 16 years
Maui County Educational Needs Assessment Survey
Faculty Senate Executive Committee: Vice-Chairperson
Faculty Senate Charter Review Committee: Chairperson

Exhibit No 13

OTHER ACTIVITIES (Selected former and present activities)

State of Hawaii: Air Pollution Control Committee, Maui County, Chairperson
Maui County: Planning Commission Member
Maui County: Board of Adjustments and Appeals Member
Maui Chamber of Commerce: Economic Development Committee
Maui County: Advisory Committee to Mayor on Energy Policy, Chairperson
Hawaii State Statistical Data Center (Agency of DPED), Maui County Representitive
UHPA Faculty Union: Community College Rep on Salary Adjustment Committee
Maui Economic Development Board: Statistics Committee
Instructor, Cable Television Course on Macroeconomics
Kula Community Association, Board of Directors
Kula Elementary School PTA, Vice-President, President
Maui County Upcountry General Plan, Citizen's Advisory Committee, Vice-Chairman

PUBLIC SPEECHES (Selected)

Numerous organizations have called upon me to address them. In each case I have taken these requests most seriously by preparing a well-documented speech. A partial list of my public speeches follows:

Maui Press Association, "Evaluation of the Maui Media"
Planners, Architects, and Landscape Architects(several times)
American Association of University Women (State Convention)
Hawaii State Association of Credit Unions (State Convention)
Humanities Foundation Community groups
Hiroshima Day Commemoration, Iao Congregational Church
St. Joseph's Church, Makawao, "Peace and Social Justice"
Maui County Women's Conference, "Comparable Worth"
Moderator for several community forums: air pollution; geothermal power; Maui's airport needs;
Moderator for candidates forums: Mayor and Maui County Council

AWARDS

1975	American Lung Association	Blue Sky Award for Efforts in Clearing Up Air Pollution
1976	Chamber of Commerce	Outstanding Young American Award
1981	Maui Community College	Merit Award
1987	University of Hawaii Board of Regents	Excellence in Teaching Award
1989	Maui Community College	Merit Award
1991	Maui Peace Network	Ho'omalu Award
1996	University of Hawaii System	Faculty Service to the Community Award
1997	Maui County Council	County Council Resolution — For service to the Maui community

Ian Chan Hodges

P.O. Box 1211
Makawao, HI 96768
(808) 572-8348

EXPERIENCE

Pacific Knowledge, Makawao, HI
Principal: 1993 — present

Since its formation in August of 1993, Pacific Knowledge has been involved in seven primary projects:
1) Organizing the Hawaii Fair Lending Coalition to analyze the geographic mortgage lending data of Hawaii's financial institutions and to carry out necessary community reinvestment challenges. The first CRA challenge resulted in a federally mandated commitment of $150 million in loans for Hawaiian Homelands. Renegotiated and strengthened this commitment during the Summer and Fall of 1997;
2) Designing, promoting and obtaining funding for Maui Microenterprise, a loan fund for small businesses operated by MEO.
3) Creating the *Pacific Monitor* – a publication focusing on economic diversification, technology and Asia-Pacific news. The *Pacific Monitor* was sent out three times a week to nearly 1,000 Maui businesses.
4) Working on developing models of community development finance on Hawaiian Homelands through the Hawaiian Homes Loan Project;
5) Initiating negotiations between a small local bank and social investors about possible acquisition and conversion to a CDFI;
6) Collaborating with community organizations in developing a successful proposal for a State of Hawaii sponsored microloan fund feasibility study, and;
7) Providing research services in socially responsible investing, consumer protection laws and ownership of local investment huis.

Center for Responsible Capital Investment, Radnor, PA
Founder & Project Director: 1992 — 1993

Formed the Center for Responsible Capital Investment to provide a forum through which to respond to the issues of community development finance brought to the nation's attention by the campaign of Bill Clinton. After Clinton's inauguration, managed the Center's work which focused on the President's initiatives involving Community Development Financial Institutions (CDFIs) and the Community Reinvestment Act (CRA). Activities at the Center included:
1) Organizing a local CDFI forum made up of six area banks, the Philadelphia Fed, the Private Industry Council, Philadelphia Development Partnership, Black Clergy, Inc. and community groups;
2) Working with individuals and institutions in Philadelphia, Baltimore and D.C. to develop a curriculum designed to train bankers in community issues and community leaders in banking; and,
3) Assisting Congressional staff in drafting a proposed educational/TA component for the Clinton Administration's CDFI legislation.

TONY! Ergonomic KeySystems, Palo Alto, CA
Consultant: 1990 — 1992

Consulted in various aspects of preparing the TONY! keyboard for market. Work involved product benefits analysis, reviewing product designs, exploring manufacturing options, performing background searches, devising marketing strategies, doing legal research, locating potential investors, creating investment instruments and developing organizational strategies. The TONY! received coverage in more than

50 publications and has also been featured on ABC, CBS, CNN, NBC and PBS. Thirty members of the Fortune 500 and hundreds of others (including four Federal agencies) submitted preproduction purchase orders for the TONY!.

The Whole Works, Main Line, PA
Partner: 1990 — 1991

Co-founded and helped manage a resource center for nonprofits located in the Philadelphia area. The Whole Works provided discounted books, fund raising assistance and computer support to the staff and clients of nonprofit institutions. Created a hybrid partnership/ proprietorship structure for this venture — allowing for both organizational flexibility and real ownership for those involved.

General Community Development Work, USA
Field Worker: 1986 — 1993

Involved in various community development activities in Philadelphia, Camden, Los Angeles and Washington, D.C.

Community Medical Clinic, Haiti
Organizer: 1987

Co-organized a relief/construction trip to Haiti for the purpose of building a community-based medical clinic. Involved in fund raising, logistics, volunteer recruitment and management.

Patsy Mink for Governor, Honolulu, HI
Assistant to the Campaign Manager: 1986

Helped coordinate Patsy Mink's gubernatorial race. Managed volunteers in mailing and phone call efforts.

Representative David Hagino, Honolulu, HI
Legislative Aide: 1985

Served as an aide to Representative Hagino with work focused within the education committees.

Abel-Benke, Honolulu, HI
Student Intern: 1982

Interned at Abel-Benke, a Hawaii-based securities firm. First encounter with a corporate takeover.

General Investment World
Student Practitioner: 1980 — Present

Developed an interest in investments at the age of 13. Went on to acquire a working knowledge of stocks, futures, options and debt instruments. Learned from most mistakes made during adolescence.

EDUCATION

First National CDFI Institute, Durham, NC
Received community development finance training in February 1994.

Eastern College, St Davids, PA
BA in Sociology with a concentration in alternative economy (1990). Additional graduate-level course work in Economic Development.

Kalani High School, Honolulu, HI
Graduated in June of 1984.

JAMES V. WILLIAMSON

CONSULTING ENGINEER

672 KUMULANI DRIVE, KIHEI, HAWAII 96753

TELEPHONE (808) 874-6151 • FAX (808) 874-5305

EDUCATION: Civil Engineering Diploma
Melbourne Technical College, Australia, 1944

Bachelor Civil Engineering
Melbourne University, Australia, 1948

REGISTRATIONS: Licensed Professional Engineer: CA, HI and WA
(Previously licensed in 24 states

LANGUAGE: English
Spanish (Second)

PROFESSIONAL SOCIETIES: Member - United States Committee on Large Dams:

Fellow - American Society of Civil Engineers

MILITARY SERVICE: Australian Army, Sapper (Engineering Corps), 1945

SPECIAL QUALIFICATIONS:

Mr. Williamson has been in professional practice since 1948. In his many years of experience in the United States and abroad, he has specialized in design and construction of heavy civil engineering structures, principally large hydroelectric and multipurpose projects. He has been engaged in investigation and design of about 130 miles of tunnels, 70 powerhouses including 10 underground installations, and 50 dams ranging up to 770 ft high. He has authored or co-authored over 20 technical publications including a number of papers relating to seismic design of dams, and rock mechanics investigations and tests for large underground openings, in addition to several on hydraulics of power conduits and the impact of hydraulic transients.

Prior to his retirement in April 1987 as a Partner of R. W. Beck and Associates, Mr. Williamson was responsible for all of the hydroelectric and other water resources projects undertaken by Beck over the last 18 years both domestically and overseas. His last assignment was Manager of Beck's Western Region and concurrently Director of International Development. In his role as Regional Manager he was also responsible for electrical control systems, transmission and substations, municipal services including roads and streets, solid waste, water and wastewater systems, and construction management.

Since April 1987 Mr. Williamson has provided independent consultant services on water resources projects involving dams, and conventional and pumped storage hydropower. He served on a review panel for several dams, and was special consultant on the rehabilitation of Big Bear Lake dam, all in southern California. He was on the consulting board for the last FERC inspection of State of California's Oroville Project. He is currently on the review panel for the 200 foot high Los Vaqueros water supply dam in the San Francisco bay area. He is chairman of the consulting board for the investigations and design of the 800 MW Parsa pumped storage project at the Dead Sea in Israel. Mr Williamson is also on the consulting board for the State of California's 1995 safety inspection of two groups of dams: Pyramid and Castaic; and Del Valle, Patterson, Clifton Court and Bethany dams.

Exhibit No. 15

Marc Brehsen

P. O. Box 826
Kihei, Maui, HI 96753-0826

Home Phone (808) 874-8124

EDUCATION

1974 BS, Meteorology; San Jose State University, San Jose, CA

EMPLOYMENT

1982-1989 **South Coast Air Quality Management District**
Air Quality Inspector: inspected air pollution sources, including process and control equipment, in industrial and commercial facilities to enforce governmental regulations and permit requirements.
Staff Specialist: Developed and managed a training program for new inspectors.
Meteorologist (acting):
Designed and conducted ambient air monitoring programs and investigations.

1979-1982 **TRW**
Meteorologist: Conducted an air quality impact analysis as part of an Environmental Impact Statement for the EPA for a proposed hazardous waste incinerator on an oil platform in the Gulf of Mexico. Responsible for air quality and meteorological surveys, including data acquisition, monitoring, quality assurance, and complete written evaluation. Modeled dispersion of proposed incinerator's emissions near the platform and onshore.

Evaluated meteorological data from non-attainment areas in Arizona, and incorporated this data into a model. Conducted a survey of emissions from fuel storage terminals during an air emissions inventory for the City of Albuquerque.

Staff Member:
Determined particle size distribution characteristics of air pollution controls on utility boilers. Recovered hazardous organic compounds sampled during emissions tests of commercial and hazardous waste incinerators.

1974-1979 **Meteorology Research, Inc.**
Field Manager: Managed field programs during large-scale engineering research tests of air pollution controls on utility power plants and industries. Supervised up to eight engineers and technicians. Sampled and analyzed particulates to determine particle size distribution and SO_2 characteristics during these tests. Prepared written reports. Served as Project Manager during portions of a full-scale study of SO_2 scrubbers.

Meteorologist:
Measured vertical wind and temperature profiles during jet airliner noise certification tests and power plant emission plume studies. Conducted quality assurance of recorded meteorological data. Maintained meteorological data monitors and recorders. Prepared climatological summaries.

Exhibit No. 16

Roy H. Smith
P. O. Box 984
Haiku, HI 96708
808-572-1804

OBJECTIVE: To prevent the permanent destruction of farmland.
To promote clean, efficient, appropriately scaled energy systems and consumption habits.

EXPERIENCE/EDUCATION:

Third generation farmer, Ohio
Hay bailer seven summers
Lifelong gardener/mechanic
Machinist and tool & die maker
Electronic/computer technician
Technical reader
Compostarian & practiced pitch forker
Farmer/field research - ADAP-Integrated Farm Development Project, University of Hawaii, 1994
- HOFA Field Trials, Kula Ag Park, 1998
Co-owner, International Plant Medicine Corporation
Consultant on organic farming
Farm manager, Melody Farm, Haiku

INTERESTS:

Technical reading in environmental issues relating to pollution and alternative, sustainable systems
Development of sustainable technologies, *i.e.*, fuel cell, solar & wind generators, hybrid refrigeration systems

AFFILIATIONS:

Board of Directors, Maui Sustainable Farm Alliance, 1990-94
Board of Directors, Hawaii Organic Farmers Association (HOFA), 1997-98
HOFA Certification Committee - Evaluator, 1994-present
Member, Sierra Club

References available upon request.

Exhibit No. 17

Erik C. Frye
PO Box 1392
Haiku, HI 96708
808-572-6700

OBJECTIVE:

To help resolve the conflict between those who see the best avaialable technology as fossil fuel-dependent combustion technology and those who envision conservation and renewable energy as the best available technology.

EDUCATION:

Bachelor of Science from University of California, Berkeley, 1984
Graduated with Honors from the College of Natural Resources
Degree in Agricultural Ecology, Conservation of Natural Resources
Continuing education and research
Graduate of the Rural Community Leadership Program, 1997

EXPERIENCE:

Owner, Farm Ecology, Orchard Design, Installation, Consultation, 1990-1998
Professional writer, editor, proofreader, researcher, and producer

Information research specializing in current scientific discoveries and technological innovations in the following areas of interest:

- Integrated Pest Management, Organic Agriculture, Reforestation
- Material sciences advances, thin-film photovoltaics, hydrogen turbines, steam turbines, solar-hybrid systems, bundled light emitting diode "bulbs," sulfur light bulbs, sonic refrigeration, rare earth magnetic refrigeration, fuel cells, integrated solar harnessing and architecture, i.e.. facades, curtain walls, roofing, skylights, awnings, canopies, rain screens...electricity and hot water in the same footprint
- Health effects of environmental pollutants, iatrogenic epidemiology, infectious encephalopathies, preventive health care

AFFILIATIONS:

Hawaii Organic Farmers Association, Certification Committee 1994-98
Independent Organic Inspectiors Association, Certification Inspector 1994-98
President, Maui Chapter of the Hawaii Tropical Fruit Growers, 1996-1998
Haiku Community Association, 1990-present

References available upon request.

Exhibit No. 18

CURRICULUM VITAE
December 1996

NAME: Steven Michael Moser

DATE OF BIRTH: July 28, 1949

PLACE OF BIRTH: Washington, D.C.

ADDRESS:

Home: 1095 Pookela Road
Makawao, Hawaii 96768

Work: 1883 Mill Street
Wailuku, Hawaii 96793

PHONE:

Home: (808) 572-8223

Work: (808) 244-3788

EDUCATION:

College:

St. Johns College
Camino Del Monte Sol
Sante Fe, New Mexico
September 1967 - May 1971
Bachelor of Arts

Stanford University
Stanford, California
July - August 1970 (summer session)
Organic Chemistry Course

Medical School:

University of Texas Southwestern Medical School
at Dallas
Harry Hines Blvd.
Dallas, Texas
September 1971 - May 1975

Internship:

University of Illinois Hospital
Department of Medicine
840 South Wood Street
Chicago, Illinois
June 1975 - June 1976

Exhibit No. 19

Internship in Internal Medicine

Residency:

University of Illinois Hospital
Department of Medicine
840 South Wood Street
Chicago, Illinois
July 1976 - June 1978 (1st and 2nd year residency in Internal Medicine)

Fellowship:

University of Southern California--
Los Angeles County Hospital
Department of Nephrology
Los Angeles, California
July 1978 - June 1980
(clinical and research fellowship in nephrology with teaching responsibilities)

Masters of Public Health:

University of Hawaii (HITS)
School of Public Health
Honolulu, Hawaii
September 1993 - present
(in process of obtaining Masters in Epidemiology on Maui using HITS)

WORK:

1980-1981	Internist and Nephrologist at Kaiser Wailuku Clinic
1980 - Present	Internist and Nephrologist in private practice
1991 - Present	Assistant Director -- St. Francis Maui Dialysis Satellite Unit

PROFESSIONAL SERVICES:

1980 - 1983	Continuing Medical Education Committee Maui Memorial Hospital (Chairman -- 1981 - 1983)
1982 - 1989	ICU-CCU Committee at Maui Memorial

Hospital (Chairman -- 1985 - 1989)

1983 - present	Chairman, Nutrition Committee, Maui Memorial Hospital
1988 (two weeks)	Guest lecturer and consultant, Manolo Morales and and Carlos Fonseca Hospitals, Managua
1990 - 1991	Chairman, Maui Memorial Hospital Autonomy Committee (drafted legislation for self-governance at MMH)
1991 - present	Maui County Management Advisory Committee at Maui Memorial Hospital (Vice Chairman 1994)
1991	Lecturer on pesticide-induced illness at Hawaii Pesticide Conference sponsored by the State Department of Health
1992	Lecturer on health and environmental effects of geothermal energy production at annual session of Hawaii chapter of American College of Physicians
1992 - present	Chairman, Maui Memorial Hospital Hospital Operations Committee (evaluation and problem-solving in inter-departmental matters of the hospital)
1993 - present	Organizer and Chairman, Visions 2000 Committee (community needs assessment and strategic planning for Maui Memorial Hospital; series of community conferences)
1993 - present	Member, Tower Committee, Maui Memorial Hospital
1993-1994	Organizer and participant of Hawaiian Diet Program at Maui Memorial Hospital (17 hospital staff participants placed on traditional Hawaiian foods for three weeks under auspices of Hui No Ke Ola Pono clinical protocol)

HONORS AND AWARDS:

1971	Thomas J. Watson Foundation Fellowship of Independent Study

1985	Maui County Humanitarian Award
1985	Hawaii Medical Association "Physician of the Year"

CERTIFICATION:

1973, 1975, 1976	National Board of Medical Examiners -- Part I, Part II, Part III
1978	American Board of Internal Medicine
1980	Board Certified in Nephrology

PROFESSIONAL SOCIETIES:

1973	Student American Medical Association (Delegate, National Convention)
1971-1973	Phi Delta Epsilon Professional Society
1976	Associate of the American College of Physicians
1980-1983	Member of the American College of Physicians
1983 - present	Fellow of the American College of Physicians
1983-1984	Maui County Medical Society -- Secretary
1984-1985	Maui County Medical Society -- President
1985	Maui County Medical Society -- Chairman, Public Health Committee
1980 - present	Hawaii Medical Association
1982-1983	Hawaii Medical Association Councillor for Maui
1986-1993	Environmental Health Committee of the Hawaii Medical Association (physicians' committee for environmental concerns such as pesticide contamination of water, air pollution, lead poisoning, medical waste disposal, sewage problems; liaison with Hawaii

Department of Health; lobbying and testimony before the State Legisature; physician education)

1989 - present — Organ Donor Society of Hawaii (Board Member 1994)

1994 — Maui County Medical Society Delegate to Hawaii Medical Association Annual Session House of Delegates

COMMUNITY SERVICE:

1981-1984 — American Cancer Society (President, (1982-1983)

1982-1989 — Mayor's Advisory Committee on the Handicapped

1982-1989 — Physicians for Social Responsibility (physicians anti-nuclear movement, supporting arms control and decreased military spending)

1983-1986 — Peacemoves (anti-nuclear activist and educational group; established nuclear free zone for Maui County)

1984-1987 — Maui Rotary Club Member

1984-1986 — Board of Advisors, State Park at Makena (citizen action group for the public preservation of Big Beach at Makena)

1984-1986 — Safe Solutions (environmental group organizing public testimony in the EIS process opposing Mediterranean fruit fly eradication plan of spraying pesticides, and federal marijuana eradication plan of spraying of herbicides

1988 — Co-plaintiff in state court seeking injunction against Strategic Defense Initiative Relay Mirror Experiment on Haleakala and Kihei

1990 — Co-plaintiff in state court in suit against Puna Geothermal Venture and State of Hawaii Department of Health

(expert witness)

PUBLICATIONS

1. Housestaff and Indigent Black Patients, Forum on Medicine; Vol. 1, July, 1978.

2. Five scientific articles published in the nephrology literature on phosphate metabolism and hormonal changes in acute renal failure (bibliography available upon request).

3. Tamoxifen: A caveat on the con side of the debate, Hawaii Medical Journal, Vol. 52:4, pp. 87-102. April, 1992

4. The Hawaiian Diet at Maui Memorial Hospital, Hawaii Medical Journal, Vol. 53:12, pp. 354-359. December, 1994.

MAUI TOMORROW BOARD MEETING MINUTES
12/15/97 - 5 PM
Landmark Maui Properties, Makawao

LAND USE COMMISSION
STATE OF HAWAII
1998 FEB 17 P 2:40

PRESENT: Susan Bradford, Lisa Hamilton, Celeste King, Mark Sheehan (Board), Scott Crawford (Staff)
ABSENT: Anthony Ranken (proxy to Susan Bradford), Ed Lindsey, Louise Rockett

CALL TO ORDER: Mark, 5:20 PM

MINUTES OF MEETING, 11/17/97, Approved as circulated.

FINANCIAL REPORT: Scott reported that we have less than $500 in our account. Scott has been paid less than the full amount; now owed estimated $800 (is actually more like $1400). Celeste donated $1,000 to be used to cover this payment and the next one. Mark said he would work with Constance in his office on fund raising.

MECO INTERVENTION: Madelyn D'Enbeau (Councilman Nishiki's office) spoke on a conference call about the process for intervention and the Dec. 22nd deadline for filing. Suggested we get a successful format from another group. Usually interventions are granted freely by LUC. She faxed info covering what must be stated in the intervention. Mark said he would find people to work on this and Board voted (Motion: Celeste/Susan) to proceed Hearing on the reclassification of over 65 acres by LUC scheduled for 2/26 and 2/27/98. Must present new evidence as an intevenor. (NOTE: Intervention papers were prepared with help of Constance Palmore, Lucienne DeNaie and Paul Atchotoff, Sierra Club, and filed on time.)

LAND BANK: Information on the bill to come before the '98 legislative session has been E-mailed to M.T. list. There is a committee talking to the different community associations seeking their endorsements and lobby efforts. Mark will donate $1,000 in January to continue this effort.

PALAUEA: Dean Witter account has a $2,000 donation to work on this effort. Susan was asked to be made a signator to this account so that she could make payments. Authorization granted via motion, with unanimous vote, including proxy from Anthony.

Celeste suggested that Susan be elected Treasurer for Maui Tomorrow; Scott will check first with Ed and Louise to see if they are interested in serving in this office, and get information on requirements.

KAMAOLE POINT: No information; check with Buck Joiner.

HANA HOTEL: Lisa reported on the Hana Hotel, bringing copy of letter sent from Keola Hana Corp., notifying employees that all employees would be dismissed when the sale is completed; some may be rehired. Sale will be completed in Jan. or Feb. '98. She also reported that her case before the Maui Liquor Control Commission had been

Exhibit No. 20

dismissed by the Judge because of failure to meet required deadlines for filing. She was not seeking anything from M. T. but said she did this personally and was considering appealing the decision.

FRIENDS OF THE HANA COAST is the group M. T. owes money for the suit filed sometime ago by Isaac Hall to stop Hana golf course building. Amount owed has been confirmed as $700, and Mark said he will pay this amount by the end of the year, keeping our promise to do so. He will seek contributions from Rick Sands and Anthony Ranken.

ELIMINATION OF LUC: Mark sent FAXes to Maui legislators and called the Governor personally. Recomends that M. T. as an organization also send protests of the elimination of LUC. Scott said he would do this, and also said M. T. needs to have a vote an an official position. Ed Lindsey has recommended setting up a Cultural Kupuna Council on each island to take the place of LUC as an avenue for contested case hearings. Motion (Lisa/Susan) for M.T. to take an official position of protesting the elimination of LUC. Vote of those present unanimous, including Susan voting Anthony's proxy.

NEWSLETTER: Scott needs articles within the next two weeks. Will include Beach Erosion, Rob Mullane; update on Keka'a, Louise & Jane; update on Palauea, Susan and Helen Felsing; MECO intervention; Airport runway lengthening (Jack Thompson); Ag. Bill (Sol's comm. Council); VIVA (Sally Raisbeck). Scott recommended that M.T. hold a meeting to set up strategy for Airport runway EIS hearing (include Sierra Club). Also that we do PSAs to be aired over AKAKU.

DOC VIDEO: Scott had copies for Board members and schedule of AKAKU airings (next airing is Saturday, January 10, 3:30 pm).

WIND FARM: This is a private development which is being worked on; final design has not been completed. Will be in Maalaea on the side of Iao Mountain.

MEETING ADJOURNED 6:30 pm.

NEXT MEETING Monday, 1/12/98, in Wailuku at Anthony Ranken's office.

Celeste N. King, Secretary

LAND USE COMMISSION
STATE OF HAWAII
1990 FEB 17 P 2:40

DEPARTMENT OF COMMERCE AND CONSUMER AFFAIRS

BUSINESS REGISTRATION DIVISION

STATE OF HAWAII

P.O. Box 40
Honolulu, Hawaii 96810

RECEIVED
FEB 21 1990
2:28 p.m.
Dept. of Commerce & Consumer Affairs
STATE OF HAWAII

Articles of Incorporation of

Maui Tomorrow Foundation, Inc.

The undersigned, desiring to form a nonprofit corporation under the laws of the State of Hawaii, certifies as follows:

I

The name of the corporation shall be:

Maui Tomorrow Foundation, Inc.

II

The address of the corporation's initial office is:

Maui Tomorrow Foundation, Inc.
3663 Baldwin Ave.
P.O. Box 428
Makawao, Maui, Hawaii 96732

III

The period of the corporation's duration is perpetual.

IV

Section 1. The corporation is organized for the following purposes:

(a) To advance the protection of Maui's precious natural areas and prime open space, for recreational use and esthetic value; to promote the concept of ecologically sound development; to preserve the opportunity for a rural lifestyle on Maui; to promote, sponsor and participate in educational and community programs, seminars and other functions related to the foregoing purposes; to carry out litigation as necessary to advance the foregoing purposes;

Exhibit No. 21

not participate in, or intervene in (including the publishing or distribution of statements) any political campaign on behalf of or in opposition to any candidate for public office.

Section 3. Notwithstanding any other provision of these Articles, the corporation shall not carry on any other activities not permitted to be carried on (a) by a corporation exempt from federal income tax under section 501(c)(3) of the Internal Revenue Code, or the corresponding section of any future federal tax code, or (b) by a corporation, contributions to which are deductible under section 170(c)(2) of the Internal Revenue Code, or the corresponding section of any future federal tax code.

VIII

Upon the dissolution of the corporation, the existing assets of the corporation shall be distributed for one or more exempt purposes within the meaning of section 501(c)(3) of the Internal Revenue Code, or the corresponding section of any future federal tax code, or shall be distributed to the federal government, or to a state or local government, for a public purpose. Any such assets not so disposed of shall be disposed of by the Circuit Court of the Second Circuit of the State of Hawaii, or any other court of competent jurisdiction, exclusively for such purposes or to such organization or organizations, as said Court shall determine, which are organized and operated exclusively for such purposes.

IN WITNESS WHEREOF, I certify under the penalties of Hawaii Revised Statutes section 415B-158 that I have read the above statements and that the same are true and correct.

DATED: Wailuku, Maui, Hawaii, February 19, 1990.



ANTHONY L. RANKEN, Incorporator
P.O. Box 261
Wailuku, Hawaii 96793
(808) 242-4387