LARGE CUSTOMER NEEDS AND WANTS STUDY

Submitted to

Angela Jones
Southern California Edison
2131 Walnut Grove Avenue
Rosemead, CA 91770

Submitted by

QUANTUM CONSULTING INC.
2030 Addison Street
Berkeley, CA 94704

P916-200

February 16, 2001

CONTENTS

CONTENTS

LIST OF EXHIBITS

EXECUTIVE SUMMARY

I. Overview

This executive summary presents the key results of the Large Customer Needs and Wants Study, conducted by Southern California Edison Company (SCE) and its consultants on behalf of the evaluators of energy efficiency (EE) programs in California that are funded by the Public Goods Charge. These program evaluators are the investor-owned utilities (IOUs)[1] and the California Energy Commission.

The goal of the project is to gather information on the needs and wants of large customers within the context of current market trends and strategic objectives in order to help the California program planners develop new and more effective energy efficiency programs for large business customers.

- The executive summary begins with a brief description of the project design and method.
- The industry groups selected for this study — a mix of growth and mature industries in both the industrial and commercial sectors — are then introduced.
- The key strategic needs and wants of the industries studied are then discussed.
- This is followed by a presentation of the recommended program strategies that may meet the needs of both California's large customers and its electric system.

The research supporting this study was conducted during the summer and fall of 2000. Results reflect industry and utility conditions at that time.

[1] Specifically, SCE, Pacific Gas and Electric Company, San Diego Gas and Electric Company, and Southern California Gas Company.

I.A. Project Design

This project was designed to develop and illustrate a general approach for identifying the needs and wants of specific industries to provide effective input to the EE program planning process.

- Accordingly, the project was structured to accomplish the following objectives:
  - Identify important strategic issues, market trends and general and industry-specific drivers, thereby supplementing information traditionally obtained from utility account executives and facility managers.
  - Make recommendations that are consistent with both broad program approaches and more targeted initiatives.
- An important element of this effort is to refine the thinking about how programs are developed.
  - Current approaches tend to result in programs designed from the perspective of facility managers, who are focused on immediate problems such as reliability, clean power, and the availability of financial incentives. Although there have been many successes over the years, participation and the associated energy savings can be enhanced.
  - In addition, most programs and program approaches have been broad scale, rather than targeted toward specific industries. Also, these programs have been oriented almost exclusively toward the use of financial incentives and, more recently, the encouragement and use of ESCO-provided services.
- Having this historical perspective in mind, a key task was to gather critical market intelligence that could be used to develop feasible responses by program planners. This entailed collecting information about the strategic issues driving specific industries, the needs and wants of large businesses within these sectors, and the implications of those needs and wants for energy-related product and service decisions, energy use, and demand. With this information in hand, program recommendations were developed that are based on the market trends and industry drivers which impact the decision processes of customers within the sectors of interest.

I.B. Specific Methods

The project objectives required a new approach, featuring in-depth background research on selected industries and, very importantly, workshops with key industry experts and decision influencers and interactions with utility representatives.

- First, an extensive literature review was conducted to incorporate lessons learned from previous research. Sources reviewed include market segment analyses, industry reports, and publications from EPRI's "Voice of the Customer" project. (EPRI, 1995)

- Next, the findings of the literature review were used to identify business segments that should be targeted for more detailed research. Experts who were knowledgeable about these segments were recruited for intensive but informal workshops, to gather market intelligence.

- The workshop findings (i.e., information on industry context, perceived needs, and recommendations made by the industry experts) were analyzed to elaborate their implications for EE program support and partnering opportunities.

  – The information gathered from the workshops and literature was used to develop a market assessment of each industry segment. These assessments — presented in Appendices A-E of this report — provide the context for the recommendations made by workshop participants and those made by the consultants for potential energy efficiency programs.

  – The key for this project was to carefully assess the workshop findings and recommendations, in order to identify feasible EE program actions that can be based on the strategic concerns of the particular industry segment. This was accomplished by first matching industry priorities with electric system priorities and then determining feasible responses for the EE program planners.

- Lastly, the workshop findings and the implications of these findings were discussed with program planners, managers, and advisors.

II. Industry Groups Selected

The industry groups selected include two of California's growth industries (semiconductors and biotechnology); one segment (aerospace) that contains components that can be characterized as either growth sectors or more mature industries; and two of California's more mature industries ¾ fruit and vegetable processing and hospitals.

A careful screening process was conducted to select the final group of industries for inclusion in this initial effort. Criteria included:

- Review of quantitative data, including overall segment size and concentration, as well as annual energy purchases and energy intensity

- Winnowing on the basis of qualitative judgments regarding energy savings potential, growth, load management opportunities, etc.

- Prioritization based on geographic balance, sector representation, and research feasibility.

This process resulted in an interesting, well-balanced group of industries for this study.

- Although growth rates have slowed somewhat, the semiconductor industry is still driven by intense time-to-market pressures and high levels of demand for chips having extremely high, state-of-the-art technical requirements, requiring expensive fabrication facilities (fabs) for which efficient use of energy and consumables is of little concern. As older generations of chips become commodities, however, they can be produced in foundries, which tend to be more concerned with production costs.

- Biotechnology — a growth industry that doubled in size between 1993 and 1999, and with revenues projected to increase to $26 billion in 2000 — is at a crossroads as it moves from a research-centered infancy to a manufacturing-oriented industry. Consequently, its operational concerns are shifting. Energy is an increasingly important part of the biotech landscape, creating possible roles for utilities in addressing joint biotech and utility industry needs.

II. Industry Groups Selected . . . Continued

- The California aerospace industry is in the process of developing a new business model, new relationships, and new funding sources to, in the case of aerospace, counteract industry downsizing and shrinking market share. The aerospace industry outlook is mixed — the satellite- and rocket-making industries are growing rapidly, but defense spending is stagnant and the production boom in commercial aircraft is ending. Non-aerospace activities are, however, growing. California's strengths lie in development and high technology applications more than assembly line production.

- California, the largest agricultural state in the nation, is also the largest food-processing employer in the US, according to the California trade and commerce agency. This study focused on the preserved fruits and vegetables group, the largest energy user among California food processors. The industry is extremely cost conscious, due to slow growth and pricing pressures, offering opportunities for energy efficiency and load management efforts that are responsive to the seasonal nature of the business.

- The hospital industry assessment focused on the acute care hospital sector, the core of the US healthcare delivery system. The industry was selected because of its somewhat unique energy use characteristics and to allow for a mix of commercial and industrial sector industries. The workshop discussion confirmed expectations regarding practice barriers to new programs, and that hospitals had already installed efficiency measures that might be considered "low hanging fruit." Regardless, even though the traditional hospital industry is in decline, workshop participants pointed out some important strategic industry needs that lend themselves to utility actions that can be beneficial to both California's hospitals and its utilities.

III. Key Findings

Analysis of the market intelligence data gathered in the workshops and literature review revealed a series of strategic needs and wants that have interesting implications for future program recommendations. In addition, strategic needs and wants tend to cluster by industry type as demonstrated in each classification below.

Market

- The more mature industries assessed — defense-related aerospace, food processing and hospitals — all face pressing needs to be low cost providers in the face of commodity business-like price competition and reduced demand.

- In contrast, the expansion of manufacturing operations is of major importance to the growth industries, especially biotech.

- Managing financial risk, while important to all industry groups, was mentioned most prominently by biotech and food processing industry experts.

- The aerospace industry, more so than any other industry segment studied, faces the challenge and the opportunity of reestablishing its market niche.

III. Key Findings (continued)

Technical

- Most workshop participants stressed the need for continued availability of a reliable infrastructure supply — labor, raw materials, and energy.

- Of special importance to the growth industries is the need to avoid process interruptions, given their intense need for rapid time-to-market.

- Semiconductor workshop participants stressed that this industry, in particular, values whatever improves productivity. Food processors, in contrast, value technological innovations to compete in a low margin business.

- Flexible production facilities are seen by the growth industries as effective tools to meet growing demand.

Regulatory

- Although workshop participants recognize that some regulation is necessary, mitigating regulatory burdens and constraints is an important part of each industry's needs. While the growth industries are primarily concerned about the effect of regulation on future growth and business prospects, the mature industries' primary concern is the effect of regulation on costs.

- The new seismic safety requirements specified in SB 1953 add substantial regulatory pressures to California's hospital industry, as well as opportunities for joint efforts between the hospitals and the EE program administrators.

IV. Recommendations and Program Strategies

A. Overview

To meet the needs of California's large customers, the recommended program strategies include: enhancing existing programs to directly increase energy efficiency and reliability; developing joint efforts to enhance productivity and efficiency; building cooperative relationships between utilities and their large customers; and providing assistance to these customers in this era of competitive transition in the utility industry.

- On a general level, industry representatives view utilities as the experts on energy-related issues, and look to utilities for guidance in this area. Workshop participants, however, indicated that utilities are perceived as failing to understand industry needs, and fault utilities for a lack of long-term commitment to their large industrial and commercial sector customers, as exemplified by standard efforts to encourage energy savings.

  – Strategic guidance should be provided in executive-level interactions, facilitated by experienced industry consultants and associations, and supported by solid background research and analysis.

  – Tactical guidance on specific energy efficiency opportunities should continue to be provided primarily by utility account representatives.

    .. Certain types of expert consultants (e.g., fabrication facility designers for the semiconductor industry) could serve as a source of credibility when working with some industries, and they are also a resource or contact for the delivery of programs and initiatives.

    .. It is also important to keep in mind that EE programs based on industry-specific market intelligence may give industry decision-makers new levers to respond to their strategic needs in ways that are beneficial to both the state's electric system and its large customers.

- Programs should be industry-specific and should be promoted as enhancing productivity first, energy efficiency second. It is very important to industry representatives that the partners in the utility / business EE consortium understand each other's businesses. There is a strong desire on the part of industry representatives to enter into mutually beneficial strategic partnerships with their utility suppliers.

IV.B. Cross-Industry Recommendations

Key cross-industry recommendations are summarized below. More detail on the cross-industry recommendations is provided in the Integrated Results chapter. Individual industries are addressed in the appendices.

Increase Energy Efficiency of Facilities

- Current ESCO programs are perceived as ineffective: they have onerous administrative and M&V requirements and are misdirected. To increase effectiveness, utility program administrators should revise program rules, streamline the administrative process and reporting requirements for ESCOs, and support ESCO activities that are attuned to industry needs.

  – Given the current environment in California, ESCOs would be extremely successful if they can cost-effectively enhance electricity reliability while helping their clients maintain reasonable energy costs — in part through the implementation of recommendations contained in this assessment.

  – A streamlined standard performance contract process would reduce the transaction costs of participation, and very importantly, increase industry receptivity by showing California's large industrial and commercial sector customers that the utilities are aware of their strategic concerns and are working to address those concerns in mutually beneficial ways.

- Educating facility managers in making the business case for energy saving and load management activities can be important in each of the industries. A key to developing a successful business case is selling the activities in the context of the more global strategic needs of key decision-makers.

- While building commissioning and retro commissioning were mentioned primarily in the hospital and biotechnology industry workshop, commissioning activities are applicable to all industry groups. Again, commissioning can be effectively sold as an important contributing factor to the industry's overriding strategic needs.

- Continuation and possible expansion of efforts to support open architecture for metering, and submetering of individual facilities, should be considered.

IV.B. Cross-Industry Recommendations (continued)

Enhance Productivity and Efficiency

- To address industry needs to reduce production costs and enhance productivity, EE program planners should also consider options that assist industries develop efficient manufacturing strategies to maintain and, in the case of the aerospace industry, win back state industry.

- Representatives of all the industries considered industry-specific demonstrations and case studies important. The specific needs to be addressed to maximize the likelihood of success of these efforts differ across industries.

- Industry representatives indicated they would welcome energy efficiency expertise in designing standardized yet flexible facilities that both meet the needs of the industry and enhance energy efficiency.

Build Cooperative Relationships

- Participants in all of the workshops stressed that utilities and their large customers should be partners. Partnerships between supplier and customer, as with any business relationship, are needed to achieve the best results over time for both the utilities and their large customers.

- Furthermore, utilities can leverage existing coalitions to assist with program design and implementation for energy efficiency, load management, economic development, and collaboration, not to mention joint political action on activities that are of concern to both the utilities and its customers. Keys here are ensuring that the coalitions are persistent and effective, and selecting the appropriate coalitions.

IV.B. Cross-Industry Recommendations (continued)

Provide Competitive Transition Assistance

- Given the current environment in California's energy market in general, and electricity market in particular, an important element of the proposed utility/industry partnerships is for the utilities to provide their customers with clear, concise and accurate information about the future of California's electricity market.

- While utility-provided assistance in managing the financial risks associated with energy price volatility was mentioned most prominently by biotech and food processing industry experts, all industry groups would most likely welcome this.

Increase Energy Reliability

- Last, but certainly not least in the minds of workshop participants, are energy-efficiency related programs designed to increase the reliability of energy supply in California. In addition to the types of energy efficiency programs mentioned above, these programs include load management strategies and distributed generation and cogeneration initiatives.

  – Utility-sponsored load management, distributed generation and cogeneration initiatives could enhance the reliability of its customers' facilities and California's electricity grid, while contributing to statewide energy conservation. Given the indicated responsiveness of the industry groups assessed to such initiatives, industry-specific applications of California's current peak reduction initiatives — as well as the adoption of new, industry-specific initiatives — should be a high, and immediate priority.

  – In keeping with the themes presented throughout this assessment, California's EE program administrators (the IOUs and the CEC) should consider integrating their current portfolio of load management initiatives in a manner that is responsive to the industry-specific needs of large customers. Information on the initiatives should be presented to key industry decision-makers in a clear, concise format, and persistent, high-level, one-on-one efforts should be made to stimulate industry participation. If necessary, initiatives should be refined and/or extended to meet the needs of California's large customers.

V. Conclusions and Next Steps

In moving forward, it is very important to keep in mind that, if energy efficiency and load management are going to persist beyond the payment of public goods charge (PGC) funds as rebates, then some or all of the other reasons for considering energy efficiency and load management need to be sold to the consumer.

- In the absence of good market intelligence, utility executives, program planners and implementers often do not have a clear idea of who makes energy-efficiency-related decisions, how the decisions are made, and how decision-makers can be convinced to make energy-efficient choices. It has become apparent that the lack of this information leaves unanswered such crucial questions as what the customers want and why they do not participate in energy efficiency programs. These factors provide the impetus for basic customer market research on the decision-making practices and the needs and wants of large business customers.

  – This research has identified and leveraged a group of decision influencers who bring an intimate but broader view of strategic industry needs. This approach has provided new insights into large customer requirements in certain sectors as they relate to the structure and delivery of energy-efficiency programs.

  – Moreover, it was found that collaboration with these market actors might, in itself, open up a previously unused channel of program delivery.

- Finally, it is possible to transform strategic market information into actionable items for program administrators, thereby enabling program planners to develop more effective energy efficiency programs targeted to large business customers. With regard to implementation of these recommendations, it is recommended that program planners:

  – Develop implementation plans for key activities, and establish longer-term timelines for implementing other recommendations.

  – Given the perception that utilities are not persistent in their efforts with these customers, long-term plans for important activities should be initiated and consistently championed.

V. Conclusions and Next Steps (continued)

Expanding industry coverage to other major industries in California is highly recommended. When expanding industry coverage, it is important to keep in mind that an overriding theme of this study, and other related investigations, is that, at the strategic level, there are many similarities across industry groups with similar needs. Program delivery should, however, be industry-specific.

- This research offers strategic guidance for expanding industry coverage. As the needs of additional industries are identified and new program strategies are uncovered, these needs and program strategies should be integrated with current recommendations to the extent possible. When additional selection criteria / drivers and / or recommendations are identified, previous industries should be revisited to assess where / if the new material is relevant to them.

- In addition, industry segments should be grouped by activity, rather than by overall industry classification. Aerospace industry divisions that specialize in electronics are more appropriately grouped with electronics industry manufacturers than aircraft builders, for example.

As discussed throughout this report, persistent and consistent efforts to understand and meet the needs of California's large customers in ways that are mutually beneficial to California's electric system and its customers are the key to success. Detailed integrated results are presented in the next chapter.

INTEGRATED RESULTS

I. Overview

The detailed integrated findings and recommendations summarized in the Executive Summary are presented in this chapter. Segment-specific findings and recommendations are presented in the appendices.

As explained in the Executive Summary, the industry groups selected for this study include two of California's growth industries (semiconductors and biotechnology); one segment (aerospace) that contains components that can be characterized as growth sectors and more mature industry groups; and two of California's more mature industries: fruit and vegetable processing and hospitals. Similarities and differences across industry groups are presented in this chapter.

- Details on the key strategic needs and wants of the industries studied are presented first.
- This is followed by a presentation of the details of the recommended program strategies summarized in the Executive Summary.

II. Key Findings . . .

A. Strategic Needs and Wants

Analysis of the market intelligence data gathered in the workshops and literature review revealed a series of strategic needs and wants that have interesting implications for future program recommendations. As illustrated in Exhibit 1, strategic needs and wants tend to cluster by industry type.

- An overview of the market, technical and regulatory needs and wants illustrated in Exhibit 1 was presented in the Executive Summary. More detailed discussions of each key finding are presented in this section, with similarities and differences across industry groups and segments highlighted.

- The needs and wants are presented in the order listed in Exhibit 1. Similarly, industry-specific discussions generally follow the order presented in the exhibit.

Exhibit 1
Summary of Industry-specific Needs and Wants

Industry Segments	Industry-specific Needs and Wants									
	Market				Technical				Regulatory	
	Be a Low-Cost Provider	Expand Manufacturing Operations	Manage Financial Risks	Re-establish Market Niche	Obtain Reliable Infrastructure Supply	Avoid Process Interruption	Enhance Productivity	Enhance Flexibility of Production Facilities	Helps Mitigate Regulatory Burdens, Constraints	Seismic Retrofitting Assistance
Semiconductor										
R&D facilities		◒				●	●	◒	◒	
Fabs		◒				●	●	◒	◒	
Foundries	◒	◒				●	●	◒	◒	
Equipment suppliers (toolmakers)		◒				◒	◒			
Biotechnology										
R&D facilities			●		●	◒		◒	◒	
Production facilities	❍	●	●		●	●		◒	◒	
Aerospace										
R&D and New Technology Development	◒		◒	●	●				●	
Assembly	●		◒	●	●				●	
Fruit and Vegetable Processing	●		●		●		◒		●	
Hospitals	●		◒		◒	◒			●	●

KEY
Importance
● High
◒ Moderate
❍ Low

Note: While many of these needs and wants are applicable to all industries (with differing levels of importance), the results presented here represent the project team's interpretation of the specific comments of workshop participants and material contained in literature.

III. Needs and Wants

A. Market

i. Be a Low Cost Provider

The more mature industries assessed ¾ defense-related aerospace, food processing and hospitals ¾ all face pressing needs to be low cost providers in the face of commodity business-like price competition and reduced demand.

The need to be a low cost provider — to compete primarily on price — was much more prevalent in the more mature industry segment than in the growth industries. Therefore, the more mature industries are more responsive to EE concerns that are the growth industries.

- In the aerospace industry, cost and, to a certain extent, political pressure drives assembly plant siting decisions.
  - The low-cost (or lowest-cost) qualified bidder wins government contracts. The low bid, which is no longer in California, typically wins production programs.
  - Labor cost is an important factor in aerospace siting decisions. Due to high labor costs, superior technology is one of California's best options for retaining aerospace business. Energy costs are also an important part of the cost structure.
  - Reducing electricity cost by itself will not help aerospace companies win major government contracts, but reducing these costs will make contracts more profitable.
- As a commodity-priced business, cost competitiveness drives fruit and vegetable processors. California fruit and vegetable processors seek cost competitiveness through operational efficiencies. Therefore, the cost and quality of critical inputs — water, labor, energy — are serious concerns to the industry.
- Hospital profits will continue to be small in the near future. The health care industry needs to develop new ways to address the next round of cost-reduction pressures because the "easy" savings gained from consolidation, integrated delivery systems, outpatient care, and certain energy efficiency measures — have been captured.

III.A.i. Be a Low Cost Provider (continued)

- Although not important in the past, production costs in general, and energy costs in particular, have become more important to some segments of the semiconductor industry.
  - Because the semiconductor industry has an intense need for rapid time-to-market and an extreme emphasis on high levels of quality production, factors that do not directly improve productivity receive relatively low priority. Less attention is paid to the cost of tools or to the consumption of energy and water; these are considered "the cost of doing business" and are often treated as fixed, not under the control of management.
  - Semiconductor makers do, however, seek to reduce costs through new manufacturing approaches, producing chips in lower-cost foundries, and outsourcing services and production. Reducing production costs is particularly important in foundries, which produce older chips that are commodities, as opposed to fabs, where time-to-market needs dominate all other concerns. Additional research is necessary to assess the implications of this trend to California facilities.
  - Semiconductor industry toolmakers are given no specifications or incentives for high levels of energy efficiency; moreover, they have no motivation to reduce the operating costs of the tools provided. The semiconductor industry practice of outsourcing to toolmakers, coupled with the lack of a trusted ESCO-like support industry, seems to impede the development and incorporation of energy efficient measures.
- Even in the biotech industry, where energy costs have not traditionally been a concern, the California energy crisis has put energy cost management on CEO's radar screens, according to workshop participants.

III.A.ii. Expand Manufacturing Operations

In contrast, expanding manufacturing operations is of major importance to the growth industries, especially biotech.

- As the biotech industry matures, more biotech companies will be manufacturing products that pass clinical trials, creating the possibility of a manufacturing capacity bottleneck. Mechanical and equipment cost elements are the two most significant cost drivers in building biotech manufacturing facilities, due to the expensive infrastructure requirements such as special electrical, exhaust, emergency power and heating, and HVAC systems.
- The semiconductor industry is characterized by a track record of considerable innovation, continuing growth of demand, global competitiveness, and huge investments. The industry continues to grow, with rapid changes in the uses of its products. The central market-related challenge facing the semiconductor industry is the need to develop new generations of chips using new materials and circuit designs to extend the historical rate of product improvement experienced by the industry and its customers.

III.A.iii. Manage Financial Risks

Managing financial risk, while important to all industry groups, was mentioned most prominently by biotech and food processing industry experts.

- Biotech is one of the most research-intensive sectors of the US economy, making access to capital and the management of financial risks essential, especially for newer biotech companies. As such, the biotech workshop participants expressed a special interest in working with utilities to develop financial mechanisms to hedge against energy price uncertainties, including examining the role of energy efficiency and load management in this effort.

- Fruit and vegetable processors, which are also well versed in financial risk management due to the seasonal nature of their business, expect that increases in electricity costs will affect the viability of their business. Workshop participants also expressed concern about uncertainty and turmoil in the deregulated energy market. They expressed a desire to work with the utilities to obtain a better understanding of how market mechanics work and strategies for shifting risk.

III.A.iv. Reestablish Market Niche

The aerospace industry, more so than any other industry segment studied, faces the challenge and the opportunity of reestablishing its market niche by leveraging California's comparative advantages in this industry to capitalize on changing market conditions.

- California aerospace companies are facing a critical problem with regard to the increasing number of production processes moving out of state. In order to win production programs, these companies must continue to be the low-cost bidder.
  - Decreasing energy costs alone is not sufficient to help aerospace companies win new contracts; these firms are in need of more comprehensive solutions.
  - However, lowering the energy costs can be a significant factor in terms of improving the profitability of a given contract.
- While defense procurement is somewhat stagnant, California can leverage its technology strengths to lead aerospace commercialization in high-demand areas, such as global positioning and communications satellites, telecommunications, and defense technologies.

These challenges provide opportunities for the aerospace industry and utilities to work together to meet mutually beneficial goals.

III.B. Technical

i. Obtain Reliable Infrastructure Supply

The continued availability of a reliable infrastructure supply ¾ labor, raw materials and energy ¾ was stressed by most workshop participants.

- Representatives of each of the industrial sector segments analyzed noted that, although electricity cost containment is important, enhancing reliability and/or increasing productivity are two primary concerns. Reliable energy is key to avoiding costly production delays because of interruptions and to meeting often demanding production delivery schedules.
  - Reliable infrastructure is, for example, very important to the aerospace industry in all areas, and especially in high tech applications. The lack of a reliable infrastructure could be the critical factor that results in lost government contracts.
  - Food processing workshop participants expressed concern with the cost and availability of three critical inputs — water, labor and energy. Technology investments make power quality increasingly important.
  - According to workshop participants, in deciding where to locate new manufacturing facilities large biotechs are considering states that are more manufacturing-friendly than California — states where costs of inputs are lower, regulations are less burdensome, and energy is perceived as reliable and reliably priced.
- In contrast, power quality was not on the hospital workshop participants' radar screens at all, despite hospitals' need for reliable, uninterruptible power. Workshop participants mentioned unsubstantiated rumors that power spikes have affected equipment, but pointed out that most critical areas are backed up, so rolling blackouts do not affect hospitals as much as they affect other industry segments.
- Given severe competition in California for highly skilled professionals and technicians, a well-trained, productive labor force is a top priority in all industries. To cite just one example, immediate access to intellectual capital is one of the main reasons the aerospace industry is still operating in California.

III.B.ii. Avoid Process Interruption

Of special importance to the growth industries is the need to avoid process interruptions, given their intense need for rapid time-to-market.

- The semiconductor industry has an intense need for rapid time-to-market and an extreme emphasis on high levels of quality production. New chips are very high-value products, but the fast pace of innovation often results in limited time available for capturing that value.
  - Certain cutting-edge operations require what engineers call "six nines," or 99.9999%, reliability. Sun Microsystems once estimated that a blackout costs up to $1 million per minute.
  - Uncertainty about California power supplies has underscored the semiconductor industry's need to spread production sites across different localities.
- According to biotech industry workshop participants, interruption of power is inconvenient from a research standpoint. From a manufacturing standpoint, it can be devastating. The biotech manufacturing process — from thawing cells to fermentation to recovery — is a continuous three to four week process. Power outages and brownouts may result in adulterated batches, causing biotech manufacturers to write off product lots as complete losses.
- Hospitals meet their need for reliable power in critical areas with back-up generation.

III.B.iii. Enhance Productivity

Workshop participants stressed that the semiconductor industry, in particular, values whatever improves productivity. Food processors, in contrast, value technological innovations to compete in a low margin business.

- The semiconductor industry values whatever improves productivity — emphasizing quality and speed of production above all else — because the rapid pace of innovation limits the time available for capturing the value of new, high-value chips. Despite their costs, other factors (including energy efficiency) are given lower priority.
  - The industry is investigating new manufacturing paradigms to overcome the physical limits of current manufacturing technologies and materials in order to increase the performance of integrated circuits.
  - Although the energy uses involved (HVAC, pumps, processing equipment, and lighting) are not exotic, the narrow tolerances and interconnectedness of the processes involved create high levels of concern that even modest changes in current configurations (due to energy-savings programs) could erode the quality of products or have adverse effects on the capability to meet quality requirements.
- The California preserved fruit and vegetable industry increasingly depends on technological innovations to reduce labor costs and increase operational efficiency. The food processing industry is, for example, a large user of programmable logic controllers, devices that control and sequence machinery in washing, sorting, mixing and packaging.

III.B.iv. Enhance Flexibility of Production Facilities

Flexible production facilities are seen by the growth industries as effective contributors to their need to meet growing demand.

- Biotech R&D facilities are constantly remodeled to meet changing scientific needs and equipment. Adaptable, flexible labs meet the demands of a dynamic research program and reduce the need for expensive renovation and retrofitting.
  - Lab work is characterized by high equipment densities and increasing reliance on instrumentation and robotics, creating frequent changes in the use of space and the role of research space. Utility systems are critical to successful lab operation.
  - Standardized designs mean that the facility is reusable, which is attractive to investors. The Association of Biotech Companies has adopted standards developed by The Nielsen Capital Group for single-tenant start-up bio-pharmaceutical research and development facilities.
  - Amgen recognized the operational advantages of generic labs and established standards to make new lab facilities more flexible.
- Similar needs exist in the semiconductor industry, where workshop participants noted that the current level of demand appears to be forcing more and more floor space — reputedly, even offices — into becoming production facilities.

III.C. Regulatory

i. Mitigate Regulatory Burdens, Constraints

Although workshop participants recognize that some regulation is necessary, mitigating regulatory burdens and constraints are an important part of each industry's needs. While the growth industries are primarily concerned about the effect of regulation on future growth and business prospects, the mature industries' primary concern is the effect of regulation on costs.

- According to workshop participants, burdensome government regulations increase aerospace industry costs; streamlining would substantially reduce the industry's regulatory costs. Furthermore, a stable and flexible regulatory environment would help reduce both the costs of investment capital and development.
  - Government-sponsored products are subject to standards and require exhaustive documentation (in case of a tragedy, every part will be tracked back to its origins, and new standards will be enacted to avoid a future tragedy). These sorts of practices drive up costs dramatically.
  - Furthermore, rapid technology developments can make regulations obsolete as soon as they are issued, implying that old regulations that are no longer relevant should be eliminated. Instead, companies are required to satisfy all of the old requirements plus any additional ones that are added.
- Food processing industry workshop participants want regulatory coordination and streamlining at the state level. While workshop participants acknowledge that regulation is needed to ensure safe, good-quality products, they seek relief from the undue burdens of the California regulatory regime.
  - Regulatory oversight will continue to drive food processing industry standards and business practices. Food quality standards in the US are recognized as some of the toughest in the world. Furthermore, according to workshop participants, fruit and vegetable processors are leaving California due to over-regulation and lack of coordination among regulatory bodies.
  - Workshop participants view government as among the most important factors in their business and the most difficult to deal with. Participants felt that the governmental infrastructure needs a redesign, but acknowledged the difficulty of streamlining such a complex regulatory environment.

III.C.i. Mitigate Regulatory Burdens, Constraints (continued)

- The semiconductor industry is concerned about how regulatory intrusiveness and unpredictability affects its business prospects.
  - Members of the semiconductor industry are concerned about regulatory intrusiveness that may affect their ability to maintain production volumes and schedules. Also, there are concerns about opening up proprietary information to regulatory review. In part to preempt overly strict regulatory initiatives, the industry has developed and maintains its own environmental, health, and safety codes and standards.
  - Concerns about the potential impact of changes in energy use and of opening up information to non-industry review affect willingness to participate in standard utility programs.
- The biotech industry fears that price controls on prescription drugs will choke industry growth by limiting profits, investment in biotech companies, and innovation.
  - Political anxiety about drug costs ultimately translates into cost pressure to biotech and the pharmaceutical industries, according to workshop participants.
  - As government representatives look for ways to keep Medicare solvent and to expand prescription drug benefits for senior citizens, the health care industry fears that government-imposed price controls on breakthrough drugs may be part of the equation. The industry fears that price controls will limit profits, thus stifling investment in biotech companies and choking the drug pipeline.

III.C.i.a. Hospitals . . .Seismic Retrofitting Assistance

The new seismic safety requirements specified in SB 1953 add substantial regulatory pressures to California's hospital industry, as well as opportunities for joint utility/hospital efforts.

- An estimated $24 billion for retrofits and new construction will be needed to bring California hospitals into compliance with new seismic safety requirements through SB 1953, which requires that California hospitals meet new seismic standards by 2002, 2008 and 2030. Seismic regulations present an area of opportunity for utilities to strategically engage the health care industry in meeting their long-term construction and retrofitting needs.

- Furthermore, at least according to workshop participants, the health care industry operates in a "Byzantine" regulatory environment.

  – The industry is highly regulated by a diverse set of agencies — 250 and counting — according to participants. For example, mobile MRIs are regulated by the California Department of Transportation.

  – Workshop participants observed that public pressures drive government intervention, such as the move towards expanding prescription drug coverage for seniors. One participant pointed to the uninsured as the next big health care issue. As public concern with the gap in access to quality health care rises, government may step in to address the issue. Such regulatory and political developments could increase healthcare industry costs, squeeze hospitals' margins and hinder their long term planning.

III.C.i.b. International

In addition, sectors of the aerospace and food processing industries seek government support in addressing international concerns.

- Tight export controls jeopardize global competitiveness in the important commercial space export market. Large commercial satellites were reclassified as weapons (no information can be handed to overseas clients) after a 1998 government investigation into allegations of the industry's selling secrets to China, resulting in a decrease in the aerospace industry's share of the world market. In addition, the transfer of regulatory control to the State Department has created a licensing backlog in satellites, launch vehicles, and their components.

- Food processing workshop participants are also concerned about international competition. China surpassed the US in 1995 as the number one producer of total tomatoes and its tomato production continues to grow rapidly. China leads the world production of asparagus, mushrooms, garlic, diced onions, potatoes, carrots, lettuce and several other commodities, according to the California League of Food Processors.

Recommendations for utility initiatives that could meet the needs of the large customer groups discussed here and California's utilities are presented in the next section.

IV. Recommendations and Program Strategies

A. Method

Based on the workshop findings, the project team developed a series of program recommendations that have the potential to meet the strategic industry-related needs and wants discussed above. The results of this effort are summarized in Exhibit 2. Highlights are discussed in this section, after a brief description of the exhibit.

- Using a three-point scale — low (open ball in the exhibit), medium (half-filled ball), high (solid ball) — workshop recommendations were evaluated on their relevance to the industry-related needs and wants discussed above and utility objectives such as likely cost effectiveness, potential broad applicability, and feasibility for near-term implementation. The recommendations that have the highest overall ranking denote those which best meet the strategic goals of both the industry and the utilities; these would be selected as potential program opportunities.

- After program planners identify the recommendations that appear to have the greatest potential for success it is important to consider relevant implication issues such as timing, budgetary requirements, and program delivery issues. Then, each feasible recommendation can be prioritized based on these factors, and on the criteria listed above.

  – The resulting portfolio of program strategies can then be used by program planners to augment and refine existing programs to provide California with a series of programs better targeted to address the needs of its large customers.

  – In addition, program planners will have a demonstrated method for using market assessment data to refine its program mix in the future to update and enhance the effectiveness of the programs in meeting the needs of both California's large customers and its utilities.

Recommendations are discussed in the order presented in the rows of Exhibit 2. Industry-specific examples are highlighted throughout.

Exhibit 2
Large Customer Needs and Wants Program Selection Matrix

Recommendations	Selection Criteria: Industry Related Needs and Wants: Market: Be a Low-Cost Provider	Market: Expand Manufacturing Operations	Market: Manage Financial Risks	Market: Re-establish Market Niche	Technical: Obtain Reliable Infrastructure Supply	Technical: Avoid Process Interruption	Technical: Enhance Productivity	Technical: Enhance Flexibility of Production Facilities	Regulatory: Mitigate Regulatory Burdens, Constraints	Regulatory: Seismic Retrofitting Assistance	IOU Related Criteria (Illustrative): Applicable Across Several Sectors	IOU Related Criteria (Illustrative): Cost Effective	IOU Related Criteria (Illustrative): Feasible for Near-Term Implementation
INCREASE ENERGY EFFICIENCY OF FACILITIES													
Support ESCO Activities Attuned to Industry Needs	A, H, F ●		F ◒ B ❍	A ❍	All ●		S, B ❍	B ◒ S ❍			◒	●	◒
Streamline SPC Process	A, H ● F ◒								All ◒		●	●	●
Educate Facility Managers re Business Case Presentations	A, H, F ◒		F ◒ B ❍				S ❍				●	●	●
Support Building Commissioning	H ●	B ◒						B ◒		H ●	●	●	●
Support Open Architecture for Metering, Submetering	F ◒ H ❍	S, B ❍						B ◒ S ❍		H ◒	◒	●	◒
ENHANCE PRODUCTIVITY AND EFFICIENCY													
R&D Collaboration	A ● F ◒						F ◒ S ❍				❍	◒	◒
Industry-specific Demonstrations and Case Studies	A ● F ◒	S, B ◒		A ◒		S ❍	S, B, F ◒			H ●	❍	◒	◒
Design Assistance		B ● S ◒						S, B ◒		H ●	◒	●	◒
BUILD COOPERATIVE RELATIONSHIPS													
Partnerships between Industries and Utilities	All ◒			A ●	All ●	S, B ●			All ●		●	●	◒
PROVIDE COMPETITIVE TRANSITION ASSISTANCE													
Advice to Industry about California Energy Market	All ●		All ◒		All ●	S, B ●			All ●		●	●	●
Financial Instruments to Manage Energy Price Risks	All ●		All ◒		All ●				All ●		●	●	◒
INCREASE ENERGY RELIABILITY													
Load Management	H ●				A, F ● S, B ◒	S, B ◒				H ●	●	●	●
Funding for Distributed Generation and Cogeneration	H ● A, F ◒				A, B ● S, F ◒	S, B ◒				H ●	●	●	●

KEY

Industry Segments	Relevance
S = Semiconductor	● High
B = Biotechnology	◒ Medium
A = Aerospace	❍ Low
F = Preserved Fruit and Vegetable	
H = Hospital	

IV.B. Increase Energy Efficiency of Facilities

i. Industry-Specific ESCO Activities

To increase the effectiveness of their ESCO programs, utility program administrators should revise program rules, streamline the administrative process and reporting requirements for ESCOs, and support ESCO activities that are attuned to industry needs.[2]

As illustrated in Exhibit 2, streamlined programs that support ESCO activities attuned to industry needs are important to the cost-based needs of the more mature industry groups, and can contribute to the needs of all industry groups to obtain a reliable energy infrastructure supply. Possible existing utility vehicles that could be refined to meet these needs include the current Large Standard Performance Contracting (SPC) program and the Third Party Initiative (TPI) program. Other industry-specific levers that can be used in promoting the programs are listed in the exhibit.

- In the view of semiconductor workshop participants, current ESCO programs are equipment-centered and focused on defined retrofit projects; they do not offer support for the necessary research into the needs and options of particular facilities and they often ignore possibly less expensive and more effective process improvements.
  - Future efforts that may be more effective with members of the semiconductor industry should include features such as a reduced emphasis on equipment replacement and an increased level of funding for design assistance.
  - In addition, it is important that the success of program elements be demonstrated in facilities similar to those of industry participants; in the absence of such demonstrations, it is not possible to dismiss the perceived risks to product quality or fabrication process continuity.

[2] Continuation of utility-sponsored incentive programs was mentioned in all of the workshops. Since the Large SPC program is the IOU's primary current mechanism for providing financial incentives to large customers, "Support ESCO Activities Attuned to Industry Needs" is used as a general category for financial incentives.

- While biotech industry facilities engineers are keenly aware of energy concerns, getting products to market outranks energy efficiency in facility management, according to workshop participants. This industry feature must be embraced in successful ESCO marketing efforts.

- When working with food processors, the unique challenges offered by seasonal loads must be addressed. Workshop participants viewed SPC as a cookie cutter approach that does not meet the needs of seasonal processors.

  – Investments in energy efficiency are not as cost effective for seasonal food processors as it is for other business sectors. One recommendation for reducing electricity costs was having food processors pool with schools and universities to obtain a flatter seasonal load shape that may result in lower energy bills.

  – In addition, IOU programs reach only 75 percent of the industry because about one-quarter of fruit and vegetable processing is done in municipal utility districts, according to workshop participants. The IOUs should coordinate with the municipal utilities that serve agribusiness in order to increase energy efficiency penetration among processors.

- Hospitals are in a marginal position financially, with relatively little market power. Cost savings from energy efficiency and demand-reduction programs should be quickly embraced by hospital administrators and boards, as long as they can do so without compromising the perceived quality of patient care. As discussed previously, hospitals will need help raising needed capital, designing facilities (including central plants, lighting, and plug loads), and going through the permitting process in a timely and efficient manner to meet the requirements of SB 1953.

Given the current environment in California, ESCOs that can cost-effectively enhance electricity reliability while assisting its clients ¾ in part through the implementation of recommendations contained in this assessment ¾ maintain reasonable energy costs would be extremely successful.

IV.B.ii. Streamline SPC Process

A streamlined SPC process would reduce the transaction costs of participation, and very importantly, increase industry receptivity by showing California's large industrial sector customers that the utilities are aware of their strategic concerns and are working to address those concerns in mutually beneficial ways.

While workshop participants recognize that some regulation is necessary, mitigating regulatory burdens and constraints are an important part of each industry's needs.

- Aerospace industry participants, for example, noted that, similar to overly burdensome federal regulations, current utility-sponsored SPC programs require extensive paperwork and M&V.

- Semiconductor manufacturers still perceive the amount of paperwork required as burdensome. Monitoring and verification requirements are also onerous and intrusive, particularly in light of chipmakers' concerns about proprietary product information.

IV.B.iii. Business Case Presentations

Educating facility managers in making the business case for energy saving and load management activities can be important in each of the industries. A key to developing a successful business case is selling the activities in the context of the more global strategic needs of key decision-makers.

The manner in which potential programs are presented can impede or facilitate their adoption. Assistance in learning how to prepare certain types of engineering recommendations for corporate review may help support energy-efficiency champions in certain facilities.

- Using the hospital industry as an example, utility representatives could facilitate communication between energy/facility managers, CFOs and corporate managers of hospital chains regarding savings potential. According to hospital workshop participants, energy efficient solutions may be sometimes ignored because plant engineers have failed to articulate the business case for those solutions to corporate decision-makers; language and status issues may impede effective communication.

- In the semiconductor industry, decision-makers are much quicker to adopt a suggestion that will increase yield or productivity, with positive environmental and energy-saving effects, than to adopt one that will save energy or provide environmental effects while also having positive effects on yield or productivity.

- In the biotech industry, manufacturing expansion and elevation of energy concerns to the CEO level offers a timely opportunity to assist energy-knowledgeable facility managers in encouraging the design of energy-efficient biotech buildings.

In the current environment, illustrating how energy efficiency and load management actions can improve the reliability of electric supply will be a key selling point.

IV.B.iv. Building Commissioning

While building commissioning and retro commissioning was mentioned primarily in the hospital and biotechnology industry workshop, commissioning activities are applicable to all industry groups. Again, commissioning is most effectively sold as an important contributing factor to the industry's overriding strategic needs.

- Impending hospital construction and seismic retrofitting presents an opportunity for building commissioning, which helps hospitals control operating costs. Utilities can encourage hospitals to reinvest in more cost efficient energy-saving building systems through initiatives to stimulate the proliferation of building commissioning.

- In the biotech industry, utilities could encourage more widespread building commissioning and retro commissioning, particularly in manufacturing facilities. In the past, commissioning was bypassed in the rush to begin utilizing a facility. Commissioning is now penetrating the R&D side; companies find it valuable in ensuring successful start-up.

  – Commissioning is becoming part of the process for starting up new manufacturing facilities, according to workshop participants. FDA regulations and validation require a rigorous commissioning process. Retro commissioning can also be beneficial.

  – Larger biotech companies are more likely to be receptive than startups with a short time horizon that are operating in survival mode.

IV.B.v. Open Architecture for Metering; Sub-metering

Continuation and possible expansion of efforts to support open architecture for metering, and sub-metering of individual facilities, should be considered.

Open architecture for metering was mentioned by food, semiconductor and biotech workshop participants. The principles are, of course, applicable to any company with a chain of facilities. Sub-metering was mentioned primarily in the semiconductor workshop; again, the principles are applicable to any industry with variable loads.

- Food processing industry representatives recommended that utilities could develop an open architecture for metering, which enables large processing companies with facilities in different utility service areas to easily retrieve and assimilate metering data.
  - Interoperability standards among utilities would help customers to better manage their energy usage across sites by bringing them into their wide area networks or ERP systems.
  - Open architecture would also enable the processing industry to benchmark energy costs.
- In the semiconductor industry, utilities can support and extend efforts to refine tools and techniques that will increase the capabilities and value of the metrology needed for standardized metrics, normalization routines, and visualization software.
  - Current industry models for assessing the "cost of ownership" for plants tend to ignore the costs of energy. Accordingly, little attention has been paid to process- or facility-level metrology (metering) and identification of "best practices".
  - Projects designed to develop benchmarking tools, case studies, and normalizing procedures for the semiconductor industry are under way at International Sematech and Lawrence Berkeley National Laboratory. Development and publication of case studies demonstrating the value of process- and facility-level metrology should continue.

IV.C. Enhance Productivity and Efficiency

i. R&D Collaboration

To address industry needs to reduce production costs and enhance productivity, utilities should also consider programs that assist industries develop efficient manufacturing strategies to maintain and, in the case of the aerospace industry, win back state industry.

- In the aerospace industry workshop, it was recommended that the utilities provide funding to organizations investigating possible process improvements in the aerospace industry that could result in substantial reductions in production costs, and enhancements in energy efficiency.
  - Both the aerospace industry and the California IOUs would benefit from programs that increase efficiency and productivity as well as reduce total operating costs, thereby making California's aerospace industry more competitive nationwide.
  - The California IOUs could consider supporting research efforts by industry experts, as opposed to developing industry-specific process expertise in-house. Partnerships with existing research organizations that work with the targeted industries should be considered.
- In the food processing industry, the target industry group would be the equipment supplier community, as this group acts as the food processors' R&D arm, according to workshop participants. Leveraging the research on agricultural products and food processing conducted at California universities such as the University of California at Davis should be considered.

IV.C.ii. Demonstrations / Case Studies

Consistent with the desire for industry-specific programs and the importance of production over efficiency, industry-specific demonstrations and case studies were considered important by representatives of all the industries. As illustrated in Exhibit 2, specific needs to be addressed to maximize the likelihood of success of these efforts differ across industries.

- Productivity enhancements are more important than straight energy efficiency to all of the industrial sector segments analyzed. Decision-makers are concerned that energy-saving measures may risk productivity, yield or quality. In the absence of industry-specific demonstrations and case studies, these perceptions may prohibit decision-makers from adopting applicable energy efficient measures.

- Successful program ideas can be expanded to address current strategies. For example, the existing "Savings by Design" program may be an appropriate framework for setting up showcases targeted specifically at the semiconductor industry. In particular, these showcases could be used to demonstrate the applicability and functionality of energy efficient HVAC technology in clean rooms, with a demonstration facility in the San Jose area.

- Industry-specific demonstrations and / or case studies were felt to be valuable by participants in all of the industry workshops. Representative industry-specific examples are presented below. Although the examples are industry-specific, the themes are applicable across industry groups.

  – Documentation — through demonstrations and / or case studies — of the successful application of collaborative aerospace industry R&D efforts is important to obtain industry acceptance.

  – Workshop participants recommended that utilities support demonstrations of new energy-efficient technologies to meet the food processing industry's need for operational efficiency as well as the utilities' need to reduce electrical load. Equipment suppliers have, for example, received grants from DOE's NICE (National Industrial Competitiveness through Energy, Environment and Economics) Program.

- In the semiconductor industry (as in other industries like aerospace and food processors) collaboration with equipment suppliers could create incentives for energy-efficient tools that meet semiconductors' production needs.
  - .. By working directly with toolmakers to absorb some of the risks and costs of investment in energy-saving features, utilities may be able to motivate more energy-efficient equipment designs. The potential costs and risks to IOUs would most likely preclude a broad program of this sort. However, demonstration program targeted towards foundries, which seek to reduce operating costs, may be worthy of consideration.
  - .. Another option is for IOUs to become the owners of the tools used in foundries, which seek to reduce operating costs, or even fabs, and lease the tools to the industry.

- Hospital participants indicated a strong desire for case studies that showed the costs of energy and indicated how such information could be used to identify areas where savings could be achieved. This will be especially important in dealing with the SB 1953 requirements.

IV.C.iii. Design Assistance

Industry representatives indicated they would welcome utility industry expertise in designing standardized yet flexible facilities that both meet the needs of the industry and enhance energy efficiency.

- In the semiconductor industry, design assistance may not only enhance productivity but also meets semiconductor manufacturers' need to swiftly develop new chips, tools and manufacturing processes. The re-tooling required to accommodate the migration to 300mm wafers, for example, creates the need for new designs, opening up opportunities for energy-saving approaches.

- Utilities could offer design assistance as a way to support biotech's desire for generic labs as it matures into a more standardized manufacturing industry.

  – Utilities can help meet the biotech (and semiconductor) industry's need for generic labs by helping to design standardized, energy efficient energy use systems for research labs.

    .. Energy use systems are critical to lab operation. The utilities can play a role in designing modular energy use systems that are energy efficient as well as robust and cost-effective.

    .. Workshop participants suggested that the utilities could best influence lab design upstream in the design / build process, because architects know little about energy efficiency.

  – Manufacturing expansion offers an opportunity for utilities to help design an energy-efficient manufacturing model.

    .. Workshop participants expressed interest in a modular manufacturing facility, but acknowledged that different bioprocesses make it difficult to build a "one size fits all" plant.

    .. On the other hand, standardized designs mean that the facility is reusable, which is attractive to investors. The Association of Biotech Companies has adopted standards developed by The Nielsen Capital Group for single-tenant start-up bio-pharmaceutical research and development facilities.

- According to hospital industry workshop participants, standardized yet flexible building practices could significantly reduce the cost of hospital construction. Specific building codes and hospital needs sometimes inhibit these practices, although energy requirements could be standardized.
  - Utilities can work with the health care industry in its retrofitting and long-term construction projects to comply with the SB 1953 seismic standards in ways that are beneficial both to the utilities and the health care industry. Utility involvement in the design phase would maximize efficiencies.
  - For example, utilities might be able to provide assistance that would decrease the time for approving design specifications by developing an energy-efficient central plant design template that is given prior approval by the relevant regulatory body. Hospitals who use this design template might benefit by decreasing the time period of approval of their specifications, while utilities can ensure high efficiency HVAC installations and back-up power generation facilities.
  - The recognition of potential limitations on continued progress on functionality — without reductions in facility and tool costs — and sensitivity to resource issues may increase the interest of industry decision-makers in approaches that would lower their production costs and energy usage.

As mentioned previously, including design assistance in existing initiatives such as SPC should be considered.

IV.D. Build Cooperative Relationships

i. Partnerships

Participants in all of the workshops stressed that utilities and their large customers should be partners. Collaboration between supplier and customer, as with any business relationship, is needed to achieve the best results over time for both the utilities and their large customers.

- Aerospace industry workshop participants perceive the needs of the aerospace industry and the IOUs as being similar; as such, forming strategic partnerships would be beneficial to both industries, and to the state as a whole. These partnerships, according to workshop participants, have the potential to increase the utility industry's presence at the state level and ultimately (though indirectly) assist the aerospace industry win and retain more contracts.

- Semiconductor workshop participants also recommended building cooperative relationships with organizations in the semiconductor industry and noted that fielding utility-industry specialized task forces offers potential leveraging opportunities.

- Biotech workshop participants strongly recommended forming collaborative relationships with industry organizations, noting that the industry would like an ongoing forum for dialogue to obtain information on items of interest such as best practices for conservation and futures contracts to hedge energy costs. Interestingly, biotech workshop participants observed that, while lobbying Sacramento to revisit deregulation is a natural response to higher energy costs, such an approach is not consistent with the biotech industry's opposition to price controls.

- Food processor workshop participants indicated, among other things, that utilities and food processors have a common interest in ensuring California's supply of high-quality water, and that California's state government needs a better understanding of wastewater. It could therefore be beneficial to utilities could participate in a coalition effort to increase Sacramento's responsiveness to manufacturers' water needs with industry organizations. In addition, coordination with municipal utilities is especially important for food processors.

Furthermore, utilities can leverage existing coalitions for energy efficiency, load management, and economic development program design and implementation collaboration, as well as for joint political action on activities that are of concern to both the utilities and its customers. Keys here are recruiting strong leadership to ensure that the coalitions are persistent and effective, and selecting the appropriate coalitions. Industry groups mentioned by workshop participants are briefly discussed below.

- The California Manufacturers and Technology Association (CMTA), an association of large energy users, is an important leveraging element that has historically been actively involved with California's utilities.

- The Semiconductor Industry Association and International Sematech publish *the International Technology Roadmap for Semiconductors.* The Silicon Valley Manufacturing Group (SVMG) is a coalition of high-tech firms and supporting industries (i.e., segments of the aerospace industry) that works with government to solve policy concerns that affect business. SVMG's energy task force currently analyzes members' energy reliability needs and develops energy efficiency and load management plans.

- The California Health Institute is very interested in beginning an ongoing dialogue with the utilities, and the Biotechnology Industry Organization is active nationally and in California.

- Aerospace associations include the national Aerospace Industries Association and the California Space and Technology Alliance, a nonprofit advocacy group that advises Sacramento on how to best support California-based space assets.

- The California League of Food Processors, the CMTA and the California Chamber of Commerce are involved in wastewater issues. The National Food Processors Association is, among other things, involved in R&D efforts that are geared to both enhance productivity and energy efficiency.

IV.E. Provide Competitive Transition Assistance

i. Advice on CA Energy Market

Given the current environment in California's energy market in general, and electricity market in particular, an important element of the proposed utility/industry partnerships is for the utilities to provide their customers with clear, concise and accurate information about the future of California's electricity market.

Presenting the results of a risk assessment of likely electricity supply and cost outcomes to industry leaders would be most useful. To cite a few examples provided by workshop participants:

- Companies in the aerospace industry need good information on the current and future outlook of the utility industry. High-level interactions between utility and aerospace industry leaders were recommended.

- Utilities should provide the biotech industry with clear, concise, and accurate information about changes in California's energy market, future electricity reliability, and costs through high-level interactions between utility and biotech industry leaders. Market intelligence is particularly critical for companies preparing for manufacturing expansion, as California's energy infrastructure factors into their strategic planning.

- Uncertainty was a recurrent theme of the food processors workshop discussion; processors need to know what is going to happen in this market and utilities are well positioned to offer expert information on the market.

IV.E.ii. Manage Energy Price Risks

While utility-provided assistance in managing the financial risks associated with energy price volatility was mentioned most prominently by biotech and food processing industry experts, all industry groups would most likely welcome this.

- Biotech industry workshop participants strongly recommended that utilities should consider assisting the biotech industry in building a portfolio of financial instruments for managing energy risk exposure and the impacts of price volatility.
  - The biotech community is familiar with sophisticated financial instruments — financing is their lifeblood — and may welcome utility-sponsored workshops on hedging energy price risks through futures and options, swaps and insurance policies.
  - Assistance in hedging energy price may offer the greatest benefit to smaller companies without sophisticated energy managers who do little more than pay their bills, according to workshop participants.
- Utilities can assist the fruit and vegetable processing industry in providing market intelligence and building a portfolio of financial instruments to minimize the impacts of price volatility.
  - Although food processors are familiar with commodity markets, workshop participants want a better understanding of how market mechanics work and strategies of shifting risk in the natural gas and electricity markets. Utilities can help educate these customers by co-sponsoring seminars on hedging strategies and other financial instruments with an industry organization.
  - Workshop discussion surfaced a grave concern with California's energy outlook, citing concern about processors' ability to absorb price hikes in the face of slim profit margins. Workshop participants feel that the viability of their business may turn on energy costs in the summer of 2001. Like biotech representatives, they speculated on the possibility of re-regulation as a temporary measure until supply and demand are realigned.

IV.F. Increase Energy Reliability

i. Load Management

Last, but certainly not least in the minds of workshop participants, are energy-efficiency related programs designed to increase the reliability of energy supply in California. In addition to the types of energy efficiency programs mentioned previously, these programs include load management strategies and distributed generation and cogeneration initiatives.

Utility-sponsored load management, distributed generation and cogeneration initiatives could enhance the reliability of its customers' facilities and California's electricity grid, while contributing to statewide energy conservation. Given the indicated responsiveness of the industry groups assessed to such initiatives, industry-specific applications of California's current peak reduction initiatives — as well as the adoption of new, industry-specific initiatives — should be a high, and immediate, priority.

- Semiconductor workshop participants indicated that incentives for load-shaving projects should be stressed.
- The biotechnology industry has been awakened to energy and energy efficiency/load management issues by the turbulence in California's energy market, as energy reliability and cost directly affect biotech companies' bottom line.
- As mentioned previously, a reliable support infrastructure — including a reliable energy supply — is critical to aerospace industry viability. Workshop participants noted that the industry would benefit greatly from programs that provide direct benefits to the industry and contribute to enhancing the reliability of California's electricity supply (from both an availability and a cost perspective).
- Load management issues surfacing in the food products workshop included advising processors on matching loads with other seasonal energy users, and exploring the possibility of shifting as much of their operations as possible to the night.
- Hospital industry participants cited load management as contributing to direct cost containment and improving load factor. For example, utilities could articulate the benefits of energy storage technologies that improve load management.

IV.F.ii. Distributed Generation / Cogeneration

Innovative distributed generation and cogeneration programs such as the pooled demand programs offered by utilities in the Midwest and utility-sponsored programs that stimulate third-party ownership and operation of on-site generation facilities should be considered.

- Financially savvy biotech companies with low tolerance for supply risk are exploring numerous options.
  - These include: investing in self-generation to provide alternate fuel capability, allowing fuel switching when prices are favorable and storage replenishment during low price periods; enhancing operating flexibility to access lower-priced supplies; and implementing cost-effective, hands-on energy management techniques.
  - One major biotech company may consider a cogeneration plant in addition to backup power generation because it cannot afford interruption of its manufacturing processes.
- Hospital industry workshop participants were interested in investigating whether or not its it feasible for them to use their back-up generation capabilities to both assist the state during emergency situations and profit from sales to the grid. In addition, hospitals want the option to use more than one type of fuel when future on-site generation facilities are redesigned. Furthermore, the increase in natural gas prices might make hospitals receptive to heat recovery systems.
- In contrast, although many semiconductor companies have generators, rarely can they supply much more than essential energy needs at the current time.

In keeping with the themes presented throughout this assessment, California's utilities should consider integrating its current portfolio of load management initiatives in a manner that is responsive to the industry-specific needs of its large customers. Information on the initiatives should be presented to key industry decision-makers in a clear, concise format, and persistent, high-level, one-on-one efforts should be made to stimulate industry participation. If necessary, initiatives should be refined and/or extended to meet the needs of California's large customers.

LARGE CUSTOMER NEEDS AND WANTS STUDY

APPENDICES

Submitted to

Angela Jones
Southern California Edison
2131 Walnut Grove Avenue
Rosemead, CA 91770

Submitted by

QUANTUM CONSULTING INC.
2030 Addison Street
Berkeley, CA 94704

P916-200

February 16, 2001

A. SEMICONDUCTOR INDUSTRY ASSESSMENT

I. Introduction

This chapter provides an assessment of the strategic needs and wants of California's semiconductor industry as input into potential utility-sponsored energy efficiency programs for California's large customers.

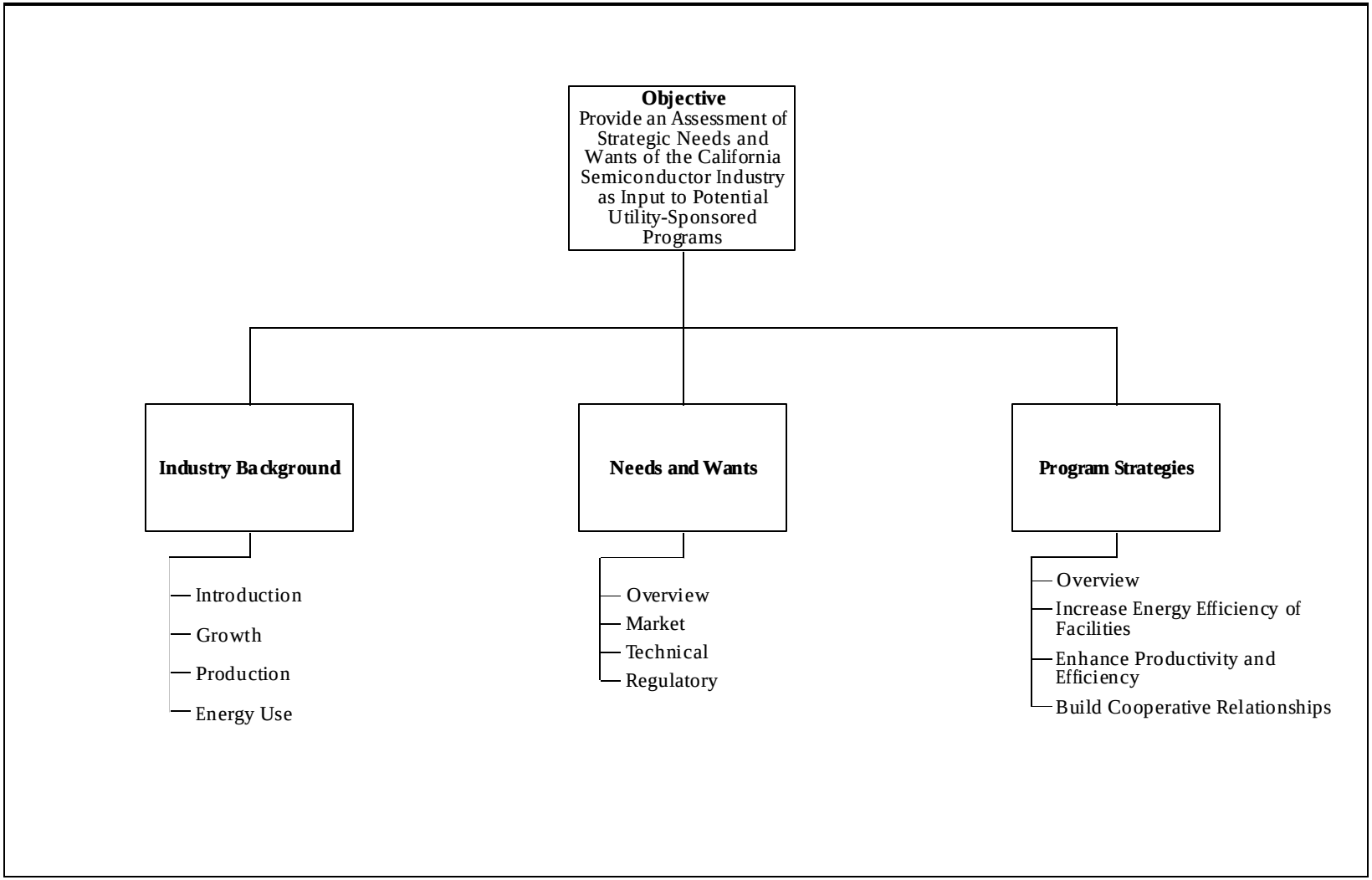
- To set the stage for the discussion of the industry needs and wants, the chapter begins with an overview of California's semiconductor industry.

- Key strategic industry needs and wants are then discussed. The semiconductor industry's market, technical and regulatory needs reflect unremitting time-to-market pressure and emphasis on high-quality production.

- Opportunities for utilities to design energy-efficiency programs to meet semiconductor industry needs are presented in the final section. These recommendations are intended to be beneficial to both California's utilities and their semiconductor industry customers.

This assessment is based on an analysis of the results of a workshop held with seven industry experts in June 2000 and a review of secondary sources. Lists of workshop participants and secondary sources are included in the appendix.

Exhibit A-1
Assessment of Semiconductor Industry Needs and Wants
As Input to Potential Utility-Sponsored Programs



II. Industry Background

A. Introduction

The needs and wants of the semiconductor industry are affected by ongoing characteristics of the markets it serves, the technology and resources it applies, and the overall economy into which it sells.

This section of the report describes several important aspects of the determining factors and relevant trends that may offer new challenges and opportunities to the industry and its members.

- The semiconductor industry is an important component of California industry in general, and to Silicon Valley in particular.
  - In 1997 (latest figures available[1]), California's semiconductor industry comprised more than 1,500 firms.
  - Their overall sales were more than $30 billion (12th among all business segments considered).
  - These firms employed more than 125,000 people (also 12th among all business segments considered).
  - They purchased over $1 billion in fuels and electric power.
- The industry continues to grow, with rapid changes in the uses of semiconductor products.
  - Semiconductors remain critical for "traditional" PCs and Macs.
  - But other computing devices (e.g., WebTV) and the Internet are adding demand — "The environment is changing in a very profound fashion. The key factor that is motivating us is the realization that the Internet runs on silicon." Andy Grove (Chairman, Intel).
  - And chips are proliferating in other appliance as well; for example:
    - .. Wireless services will be provided by perhaps 1.4 billion handsets in 2004, according to analysts.
    - .. Kitchen appliances can surf the Internet.
    - .. Cell phones can display an on-line version of The New York Times.
  - As a result of these factors, the Semiconductor Index (SOX) grew more than threefold since January 1999 (from 350.56 to 1245.78) to just before the April 2000 sell-off in technology stocks.
  - For the industry as a whole, YTD chip sales are 38% ahead of the comparable period for 1999.
  - CY2000 sales are expected to reach $195 billion, growing to $312 billion in CY2003.

[1] Data from NAICS

II.B. Growth

The semiconductor industry is characterized by a track record of considerable innovation, continuing growth of demand, global competitiveness, and huge investments.

- Historically, the industry has been able to increase the functionality of integrated circuits by leaps and bounds—roughly doubling the capabilities of computer chips every 18-24 months. Moreover, the industry has been able to do this while reducing the cost per function approximately 25% per year.
  - This trait is known as Moore's Law, in honor of Gordon Moore, one of the founders of Intel, who first made the observation / prediction about industry progress in 1965.
  - In the 26 years from 1971 to 1997, the number of transistors on a chip increased more than 3,200 times.[2]
- Market growth for integrated circuits has averaged approximately 15% per year.
  - Part of this growth is attributable to increasing societal reliance on computers and their proliferation.
  - But, especially more recently, the growth also stems from the many new devices and applications that have been developed throughout industry, business, and homes.

[2] Intel "Processor Hall of Fame," http://www.intel.com/intel/museum/25anniv/hof/moore.htm

II.B. Growth (continued)

- The global nature of the semiconductor business can be illustrated by a variety of indicators.
  - The Asian financial crisis of the late 1990s depressed demand, production, and profitability throughout the world.
  - Fire at a Japanese plant caused worldwide supply problems.
  - Preparation of the industry's most recent technical roadmap involved five regional trade associations; namely, the Semiconductor Industry Association (U.S.), EECA (Europe), KSIA (Korea), EIAJ (Japan), and TSIA (Taiwan).
  - Many U.S. plants are owned by foreign firms (e.g., MSA, Siemens, and Wacker).
- A new production facility now requires over $1 billion in investment, given the need for the building and controls required for product purity, as well as the tooling required.[3]
  - Other requirements include access to or ability to produce high volumes of clean water and access to an educated labor force.
  - Moreover, the initial life of a facility may be as short as three years, given continuing innovations that will make the current product obsolescent.

[3] As a counterpoint to Moore's Law, Rock's law suggests that the capital cost of tools will double every four years.

II.C. Production

As a result, the semiconductor industry has an intense need for rapid time-to-market and an extreme emphasis on high levels of quality production.

- New chips are very high-value products, but the innovations described/predicted by Moore's Law mean that the time available for capturing that value is limited.
- Accordingly, industry participants emphasize quality and speed of production above all else.
  - Semiconductor chips must be manufactured to exacting standards; chemical contaminants or simple dust particles can destroy them. Properly run clean rooms are a necessity.
  - Production lines run at full capacity on a 24/7 schedule. The maintenance of tools and managing the flow of feedstock and consumables used in processing chips is critical.
- Thus, the industry values whatever enables or improves productivity. Among valued factors are improved tools and chemicals.
- In contrast, factors that do not directly improve productivity receive much lower priority. Less attention is paid to the cost of tools or to the consumption of energy and water; these are considered "the cost of doing business" and are often treated as fixed, not under the control of management.

II.D. Energy Use

Despite the relative lack of attention to the cost of inputs, the semiconductor industry is a major consumer of power and other resources to fuel and sustain its production.

- Running at full capacity, semiconductor fabrication plants (fabs) consume vast amounts of energy, chemicals, and waters.
  - The energy use intensity of businesses in this sector falls just below that of paper and allied products plants.[4]
  - Large volumes of toxic chemicals and gases are used in producing chips, including ammonium chloride, hydrochloric acid, sulfuric acid, nitric acid, argon, deuterium, hydrogen bromide, chlorine, and ammonia; these must be moved safely and flushed out of the system, often through dilution with large amounts of water.
  - Post-processing of toxic wastewater takes place on-site; most plants are closely monitored by municipal water providers to ensure proper pretreatment before the wastewater is released from the fab.
  - It is not unusual for a plant to consume 1 million gallons of water a day.

[4] More detailed information is available—e.g., annual MWh per facility (*Nonresidential Program Market Size Assessment*, 1999)—but proprietary to PG&E.

- The energy end uses involved are not in themselves exotic; the most important, with respect to power consumption are:
  - HVAC: The special requirements for air handling in clean rooms result in heavy loads on HVAC equipment; multi-stage air filtration requires sophisticated equipment and air temperatures must be maintained to strict levels.
  - Pumps: Ultra-pure water is produced on site, used in processing semiconductors, and treated before being released from the plant.
  - Processing: Production depends on sophisticated, energy-intensive tools, whose process chemistry temperatures (both heating and cooling) must be maintained to exacting levels.
  - Lighting: High levels of lighting are typical.

The reticence to focus on such issues as energy consumption does not reflect a simple lack of concern.

- As noted above, the energy end uses involved are not exotic.
- What does appear to be relatively unusual are the narrow tolerances and interconnectedness of the processes involved.
  - Concern is high that even modest changes in current configurations could erode the quality of products as even minute increases in contamination are allowed.
  - Moreover, such changes could also have adverse effects on the capability to meet the stringent standards required for the handling of the toxic chemicals involved in or resulting from chip production.

Moreover, as part of its overall planning effort, the semiconductor industry is cognizant of its resource-use and environmental responsibilities.

III. Needs and Wants

A. Overview

The semiconductor industry's market, technical and regulatory needs reflect unremitting time-to-market pressure and emphasis on high-quality production.

Exhibit A-2 displays the industry's needs, ranked by importance, by four key industry segments — R&D facilities, fabs, foundries, and equipment suppliers — that differ in terms of production processes and therefore needs.

- The primary market need currently facing semiconductor firms is developing new generations of chips to protect its market. Minimizing time to market will continue to be a key to retaining market share. Efforts to develop new generations of chips in a cost-effective way are driving changes in designs, tools and production processes, many of which have implications for facility energy use.

- Semiconductor makers also seek to reduce costs through new manufacturing approaches, producing chips in lower-cost foundries, and outsourcing services and production. Reducing production costs is particularly important in foundries, which produce older chips that are commodities, as opposed to fabs, where time-to-market needs dominate all other concerns.

- The semiconductor industry's main technical needs are to enhance productivity and avoid process interruptions. Fabs and foundries, as well as toolmakers, are key to productivity improvements.

- The industry is concerned that regulatory intrusiveness will negatively affect chipmakers' production schedules. Regardless, the industry is cognizant of its resource-use and environmental responsibilities.

Market-related needs are discussed in more detail below.

Exhibit A-2
Summary of Industry-specific Needs and Wants
Semiconductor Industry

Industry Segments	Industry-specific Needs and Wants									
	Market				Technical				Regulatory	
	Be a Low-Cost Provider	Expand Manufacturing Operations	Manage Financial Risks	Re-establish Market Niche	Obtain Reliable Infrastructure Supply	Avoid Process Interruption	Enhance Productivity	Enhance Flexibility of Production Facilities	Helps Mitigate Regulatory Burdens, Constraints	Seismic Retrofitting Assistance
Semiconductor										
R&D facilities		◒				●	●	◒	◒	
Fabs		◒				●	●	◒	◒	
Foundries	◒	◒				●	●	◒	◒	
Equipment suppliers (toolmakers)		◒				◒	◒			
Biotechnology										
R&D facilities			●		●	◒		◒	◒	
Production facilities	○	●	●		●	●		◒	◒	
Aerospace										
R&D and New Technology Development	◒		◒	●	●				●	
Assembly	●		◒	●	●				●	
Fruit and Vegetable Processing	●		●		●		◒		●	
Hospitals	●		◒		◒	◒			●	●

KEY
Importance
● High
◒ Moderate
○ Low

III.B. Market . . .

i. Expand Manufacturing Operations

The central market-related challenge facing the semiconductor industry is the need to develop new generations of chips using new materials and circuit designs to extend the historical rate of product improvement experienced by the industry and its customers.[5]

The semiconductor industry is unusual in its collaborative development and open publishing of a "Roadmap" describing the technological challenges facing members of the industry over the next 10-15 years as well as a range of possible solutions for meeting those challenges.[6] According to the Roadmap:

- Physical limits to the capabilities of current manufacturing technologies and materials impede further progress in the industry unless new materials, techniques and circuit designs are developed.

- To address this problem, the Roadmap discusses several new potentially cost-effective design directions that are under development or active study, including:

  – Improved chip architecture, including integration of multiple silicon technologies on a single chip and integration of silicon technology with package technology.

  – Moving from 200mm to 300mm wafers, with attendant increases in the capacity of each chip.

---

[5] A lay discussion of this issue may be found in *Time* (June 19, 2000, pp. 98-99).

[6] Cf. *International Technology Roadmap for Semiconductors* (1999 edition). Semiconductor Industry Association *et al.* http://www.itrs.net/1999_SIA_Roadmap/Home.htm. The interested reader can learn more about International Sematech (and link to the Roadmap) from http://www.sematech.org. Additional information about the Semiconductor Industry Association is available at http://www.semichips.org.

- Although the industry is highly competitive and fiercely protective of intellectual property rights, it characterizes the issues discussed in the roadmap as falling into a shared "pre-competitive" domain. Regardless, IP issues such as protecting chip designs and capitalizing on their marketability before they are copied or otherwise made obsolete is critical to a firm's success.
  - The fear that design secrets might be compromised makes industry members highly sensitive to the risks involved in partnering opportunities.
  - These intellectual property concerns affect the willingness of industry members to expose information about energy-related applications and use.

III.B.ii. Be a Low Cost Provider

Chipmakers seek cost savings through new manufacturing paradigms, the replacement of fabs by foundries, and outsourcing, trends that raise implications for the utilities supplying power to the R&D facilities that address those challenges and the factories that produce the chips themselves.

- New manufacturing paradigms — At some point in the not-too-distant future, it is assumed, manufacturing processes will have to change, with factory integration becoming more prevalent.
  - As stated in the Roadmap: "It is . . . difficult for most people in the semiconductor industry to imagine how we could continue to afford the historic trends of increase in process equipment and factory costs for another 15 years! Thus, future editions of the Roadmap may begin pointing toward more radical approaches to perpetuate our ability to further reduce the cost-per-function and increase the performance of integrated circuits. It is probable that such approaches will involve new devices as well as new manufacturing paradigms."
  - Relevant needs mentioned in the Roadmap include "improved factory productivity through cost reduction; adaptability in the face of change; improved reliability and availability; and shorter production cycle time." Potential solutions include "increased reliance on factory automation and systematization," as well as larger-scale factory operations.

- Replacement of fabs by foundries — Historically, the industry has been driven by high levels of demand for chips having extremely high, state-of-the-art technical requirements, requiring expensive fabrication facilities (fabs) for which efficient use of energy and consumables was of little concern. As older generations of chips become commodities, however, they can be produced in foundries, which tend to be more concerned with production costs. Additional research is necessary to assess the implications of this trend to California facilities.

  – Often, a chip design has been developed at an R&D center in California and then produced at a fab elsewhere in the U.S. When that chip becomes a commodity item, its production may then be moved to an offshore foundry.

  – However, the current level of demand appears to be forcing more and more floor space in California — reputedly, even offices — into becoming production facilities.

- Outsourcing — Many semiconductor firms have turned to outsourcing of both services and production as a means of managing costs and maintaining focus on technological development

  – Among the activities now being outsourced are waste disposal and tool maintenance, as well as the production of certain types of chips. The companies to which these functions are outsourced may be more traditional in their orientation to energy use and may be amenable to conventional utility programs.

  – Moreover, it seems possible that some such companies may aggregate such functions as energy management in a number of fabs or foundries.

Technological-related needs are discussed next.

III.C. Technical

i. Enhance Productivity

The industry values whatever improves productivity — emphasizing quality and speed of production above all else — because the rapid pace of innovation limits the time available for capturing the value of new, high-value chips.

- The industry Roadmap calls for new manufacturing paradigms to overcome the physical limits of current manufacturing technologies and materials in order to increase the performance of integrated circuits.
  - Increased wafer size and consequent retooling—Advances in silicon growing technology and quality control are allowing the development of 300mm crystals, which result in greater yield per wafer with less waste.
  - Integrated chips—The increased area of the crystal, coupled with advances in lithography, allow the integration of logic functions within a single chip, allowing each chip to be tailored to specific needs.
  - Single wafer production—Larger wafers increase the economic viability of producing units singly rather than via a batch process.
- Although the energy uses involved (HVAC, pumps, processing equipment, and lighting) are not exotic, the narrow tolerances and interconnectedness of the processes involved create high levels of concern that even modest changes in current configurations (due to energy-savings programs) could erode the quality of products or have adverse effects on the capability to meet quality requirements.
  - Industry members are skeptical that energy utilities have the specific knowledge about their research needs and production requirements to provide useful, targeted advice.
  - Industry members are also aware of past experiences where "here-today; gone-tomorrow" utility programs left industry players in a compromised position; assuming the continuing existence of a program only to have the program end prematurely is of concern.

Efforts to improve productivity and reduce production cycle time will drive changes in the designs and tools involved. These changes have implications for facility energy use, such as the need for retooling.

III.C.ii. Avoid Process Interruption

Semiconductor manufacturers seek to avoid costly process interruptions.

- Certain cutting-edge operations require what engineers call "six nines," or 99.9999%, reliability. They can tolerate outages totaling no more than 31 seconds a year, or about nine one-hundredths of a second per day. This extreme reliability need make power outages very costly. Sun Microsystems once estimated that a blackout costs up to $1 million per minute.[7]

- Although many companies have generators, rarely can they supply much more than essential energy needs. Backup capacity at Intel's Santa Clara plant can only power the plant's safety equipment.[8]

- Uncertainty about California power supplies has underscored the semiconductor industry's need to spread production sites across different localities. "Silicon Valley is a great place to be, but if you're a large manufacturer you don't want to have everything here. Not only is this earthquake country, but we're seeing that obviously power is not something you can depend on 365 days a year, 24 hours a day," said LSI Logic spokesman Kevin Brett.[9]

[7] "Tech Firms Alarmed by power Crunch," *San Jose Mercury News*, December 8, 2000

[8] Ibid.

[9] Ibid.

III.D. Regulatory

i. Mitigate Regulatory Burdens, Constraints

The semiconductor industry is concerned about how regulatory intrusiveness and unpredictability affects its business prospects.

Members of the semiconductor industry are concerned about regulatory intrusiveness that may affect their ability to maintain production volumes and schedules. Also, there are concerns about opening up proprietary information to regulatory review. In part to preempt overly strict regulatory initiatives, the industry has developed and maintains its own environmental, health, and safety codes and standards

- Industry participants wish to maintain good corporate citizenship, but these interests can be overridden by corporate decisions at a global level. For example, resource conservation tends to take a backseat to the unremitting time-to-market pressure.

- On the other hand, the Roadmap recognizes "increasing societal demand for resource conservation and for effective measures to counter climatic change," and sees that "Efforts to reduce energy consumption in semiconductor production factories and facilities help to eliminate a major cause of global warming and mitigate the factors contributing to climatic change."

- Again, concerns about the potential impact of changes in energy use and of opening up information to non-industry review affect willingness to participate in standard utility programs

Possible utility program strategies designed to meet the needs of the semiconductor industry and California's utilities are discussed in the following section.

IV. Program Strategies

A. Overview

Several program strategies can counterbalance concerns and constraints on energy-saving activities by members of the semiconductor industry.

In evaluating these recommendations, it is important to consider that semiconductor workshop participants indicated a perceived lack of knowledgeable, committed support from IOUs, exemplified by the standard IOU efforts to encourage energy savings. This perception can be overcome by developing initiatives that recognize the specific needs of the semiconductor industry.

- Utilities can help increase the energy efficiency of facilities by streamlining the SPC process, supporting semiconductor-specific ESCO activities, educating facility managers in making the business case for energy-saving initiatives and facilitating submetering.
  - Utilities must be sensitive to the industry's strong concerns about the potential for changes in one aspect of plant functioning, such as energy use, may have cascading effects on other functions (such as pump pressure) and lead to degradation of product quality or interruptions in the fabrication process.
  - For the industry, the magnitude of these significant risks outweighs the expected value of the savings anticipated.
- Utilities can help enhance productivity and efficiency through partnerships with toolmakers, semiconductor-specific demonstration projects and design assistance.
- Building cooperative relationships with organizations in the semiconductor industry, such as the Semiconductors Industry Association and/or International Sematech, and fielding utility-industry specialized task forces offers potential leveraging opportunities. In addition, there is potential for developing projects that may leverage or coordinate with ongoing efforts to increase the energy efficiency of the industry in the Pacific Northwest ("the Silicon Forest") and research in progress at the Lawrence Berkeley National Laboratory.

Each of these program strategies is discussed on the following pages.

Exhibit A-3
Semiconductor Industry Needs and Wants Program Selection Matrix

Recommendations	Selection Criteria: Industry Related Needs and Wants — Market: Be a Low-Cost Provider	Market: Expand Manufacturing Operations	Market: Manage Financial Risks	Market: Re-establish Market Niche	Technical: Obtain Reliable Infrastructure Supply	Technical: Avoid Process Interruption	Technical: Enhance Productivity	Technical: Enhance Flexibility of Production Facilities	Regulatory: Mitigate Regulatory Burdens, Constraints	Regulatory: Seismic Retrofitting Assistance
INCREASE ENERGY EFFICIENCY OF FACILITIES										
Support ESCO Activities Attuned to Industry Needs					●		❍	❍		
Streamline SPC Process									◒	
Educate Facility Managers re Business Case Presentations							❍			
Support Building Commissioning										
Support Open Architecture for Metering, Submetering		❍						❍		
ENHANCE PRODUCTIVITY AND EFFICIENCY										
R&D Collaboration							❍			
Industry-specific Demonstrations and Case Studies		◒				❍	◒			
Design Assistance		◒						◒		
BUILD COOPERATIVE RELATIONSHIPS										
Partnerships between Industries and Utilities	◒				●	●			●	
COMPETITIVE TRANSITION ASSISTANCE										
Advice to Industry about California Energy Market	●		◒		●	●			●	
Financial Instruments to Manage Energy Price Risks	●		◒		●				●	
INCREASE ENERGY RELIABILITY										
Load Management					◒	◒				
Funding for Distributed Generation and Cogeneration					◒	◒				

KEY
Relevance
● High
◒ Medium
❍ Low

IV.B. Increase Energy Efficiency of Facilities

i. Streamline SPC Process

A streamlined SPC process would reduce the transaction costs of participation.

- Semiconductor manufacturers still perceive the amount of paperwork required as burdensome. Monitoring and verification requirements are also onerous and intrusive, particularly in light of chipmakers' concerns about proprietary product information.

- In addition, it is important that the success of program elements be demonstrated in facilities similar to those of industry participants; in the absence of such demonstrations, it is not possible to dismiss the perceived risks to product quality or fabrication process continuity involved.

IV.B.ii. Industry-Specific ESCO Activities

Utilities could support the development and activities of ESCOs that more directly meet the needs of the semiconductor industry. Understanding and meeting the industry's needs is critical to ESCO success.

- Current ESCO programs are equipment-centered and focused on defined retrofit projects; they do not offer support for the necessary research into the needs and options of particular facilities and they often ignore possibly less expensive and more effective process improvements. Future efforts that may be more effective with members of the semiconductor industry should include features such as a reduced emphasis on equipment replacement and an increased level of funding for design assistance.

- In addition, it would be worthwhile to reconsider administrative procedures that favor firms that can afford high carrying costs.

  – This design characteristic reduces interest in projects with longer paybacks.

  – It favors ESCOs with major corporate backing, to the detriment of smaller — and often, more innovative — firms.

  – As a result, the number of knowledgeable, experienced, well-funded service providers appears limited.

- Incentives for load-shaving projects should be stressed.

IV.B.iii. Business Case Presentations

Utilities can help educate facility managers in making the business case for energy-saving activities.

The manner in which potential programs are presented can impede or facilitate their adoption. Modest assistance in learning how to prepare certain types of engineering recommendations for corporate review may help support energy-efficiency champions in certain facilities.

- Engineering solutions are sometimes ignored because their champions have failed to understand and articulate the business case for those solutions to corporate decision-makers.

- Emphasizing how energy efficiency initiatives help meet semiconductor manufacturers strategic needs will help foster acceptance of recommendations. For example, decision-makers are much quicker to adopt a suggestion that will increase yield or productivity, with positive environmental and energy-saving effects, than to adopt one that will save energy or provide environmental effects while also having positive effects on yield or productivity.

- It is important to keep in mind, however, that as the practice of outsourcing spreads to production activities, it seems likely to distance semiconductor executives and managers even further from issues such as energy use than does the current approach.

  – Industry members are offloading any direct responsibility for resource use.

  – However, it is possible that the firms that accept the outsourced assignments would be more amenable to improvements or programs that reduce their energy costs, in that their profitability would seem directly tied to such factors.

IV.B.iv. Open Architecture for Metering; Sub-metering

Utilities can support and extend efforts to refine tools and techniques that will increase the capabilities and value of the metrology needed for standardized metrics, normalization routines, and visualization software.

- Current industry models for assessing the "cost of ownership" for plants tend to ignore the costs of energy. Accordingly, little attention has been paid to process- or facility-level metrology (metering) and identification of "best practices".
  - Sensors and recording equipment necessary for such projects are not normally installed.
  - Metrics do not exist for normalizing across plants, even within a single company.
- Utilities can develop and encourage publication of case studies demonstrating the value of process- and facility-level metrology.
  - IOUs might provide clearinghouse functions for the sharing of such information.
  - This information is crucial for benchmarking both within and between companies.
  - The results can also provide value to other industries with a stake in the way in which fabs operate, such as insurance companies.

IV.C. Enhance Productivity and Efficiency

i. R&D Collaboration

Collaboration with equipment suppliers could create incentives for energy-efficient tools that meet semiconductors' production needs.

- Semiconductor manufacturers demand the most advanced tools to meet their production needs, currently offering toolmakers no specifications or incentives for high levels of energy efficiency. Furthermore, toolmakers face obsolescence issues, just as do the chip designers and fab owners. Accordingly, their interest in the long-term efficiency of the tools they provide and their investment in energy-saving features is not considered a high priority.
  - By working directly with toolmakers to absorb some of the risks and costs of investment in energy-saving features, utilities may be able to motivate more energy-efficient equipment designs. Some might imagine a "Green Tools" collaborative.
  - The potential costs and risks to IOUs would most likely preclude a broad program of this sort. However, demonstration program targeted towards foundries, which seek to reduce operating costs, may be worthy of consideration.
- Another option is for IOUs to become the owners of the tools used in foundries, which seek to reduce operating costs, or even fabs, and lease the tools to the industry.
  - In this scenario, the IOUs would bear the responsibility of providing plants with high quality, productive, cost-effective tools; but as the direct purchasers of those tools, they would transmit energy-saving specifications to toolmakers.
  - As with the previous recommendation, the direct costs and risks to IOUs would obviously be considerable if an effort were made to carry out such a program at a broad level. Again, however, it may be useful to consider whether a limited demonstration effort would be feasible and useful.

IV.C.ii. Demonstrations / Case Studies

Utilities must demonstrate that the solutions they offer are compatible with — or will enhance — the time-to-market needs of semiconductor manufacturers in order to dismiss the perceived risks involved.

- Successful program ideas can be expanded to address current strategies. For example, the existing "Savings by Design" program may be an appropriate framework for setting up showcases targeted specifically at the semiconductor industry. In particular, these showcases could be used to demonstrate the applicability and functionality of energy efficient HVAC technology in clean rooms, with a demonstration facility in the San Jose area.
- Investing in foundry demonstrations should be considered. Cost-conscious managers of foundries may be more amenable to standard energy-efficiency programs than managers of fabs have been.
- IOUs should leverage projects underway at International Sematech and Lawrence Berkeley National Laboratory[10] that are designed to develop benchmarking tools, case studies, and normalizing procedures.
  - Additional efforts, possibly through the Third Party Initiative program, should be considered to facilitate the development of economic models for the semiconductor industry that give greater weight to energy and other resource issues.
  - Development and publication of case studies demonstrating the value of process- and facility-level metrology should continue.
- As with other program elements, it is important that the utilities and their trade allies offer solutions that are compatible with — or will enhance — the time-to-market needs of semiconductor manufacturers. ? Documenting successes within the industry should be a priority; areas of focus should include:
  - Identifying the non-energy benefits (i.e. enhancing productivity).
  - Demonstrating that risks to purity, yield, productivity, and time-to-market are minimal.

[10] Pacific Gas & Electric is helping to sponsor some of the LBNL work.

IV.C.iii. Design Assistance

Design assistance not only enhances productivity but also meets semiconductor manufacturers' need to swiftly develop new chips, tools and manufacturing processes.

- The re-tooling required to accommodate the migration to 300mm wafers, for example, creates the need for new designs, opening up opportunities for energy-saving approaches.
  - The recognition of potential limitations on continued progress on functionality — without reductions in facility and tool costs — and sensitivity to resource issues may increase the interest of industry decision-makers in approaches that would lower their production costs and energy usage.
- As mentioned above, including design assistance in existing initiatives such as SPC should be considered.

IV.D. Build Cooperative Relationships

i. Partnerships

Cooperation with organizations in the semiconductor industry would serve to leverage resources and to establish a strong relationship with trusted members of the industry community.

- The semiconductor industry's openness to cooperative efforts in "pre-competitive" arenas offers potential leveraging opportunities; for example:
  - International Sematech—a research consortium that includes many (but not all) semiconductor industry leaders — is helping to lead an investigation of industry economic models that could increase markedly the attention paid to power usage.
    - However, it will be necessary to assess which possible partnerships would be most productive for the IOUs. International Sematech is funded by many leaders of the semiconductor industry, but does not include all members of that industry.
    - It is interesting to note that International Sematech's attempts to work with EPRI appear to have foundered on certain EPRI contractual procedures, including intellectual property issues. Those issues need not bar relationships with the California IOUs.
- It may also be possible to establish cooperative relationships with other organizations affecting energy efficiency or other resource efficiencies (e.g., water utilities, wastewater treatment facilities, and filtration manufacturers) at a national level or in other states/regions where the industry is centered (e.g., Pacific Northwest, Texas). Several manufacturers and other industry stakeholders have, for example, had positive experiences in projects sponsored by the Northwest Energy Efficiency Alliance. Some of these projects have demonstrated the value of partnering with organizations concerned with energy efficiency.
- Executive-executive contacts could take advantage of the industry's sensitivity to resource concerns and its desire to cooperate with local communities. An example might be the development of an industry leadership collaborative to address climate change issues.

The assessment of California's biotechnology industry is presented in the next chapter.

B. BIOTECHNOLOGY INDUSTRY ASSESSMENT

I. Introduction

This chapter provides an assessment of the strategic needs and wants of California's biotech industry as input into potential utility-sponsored energy-efficiency programs for California's large customers.

One of the major conclusions of this chapter is that biotechnology — a growth industry that doubled in size between 1993 and 1999, and with revenues projected to increase to $26 billion in 2000[1] — is at a crossroads as it moves from a research-centered infancy to a manufacturing-oriented industry. Consequently, its operational concerns are shifting. Energy is an increasingly important part of the biotech landscape, creating possible roles for utilities in addressing joint biotech and utility industry needs. An outline of the chapter's contents is presented in Exhibit B-1 and summarized below.

- To set the stage for discussion of the industry's needs and wants, the chapter begins with an overview of California's biotechnology industry.

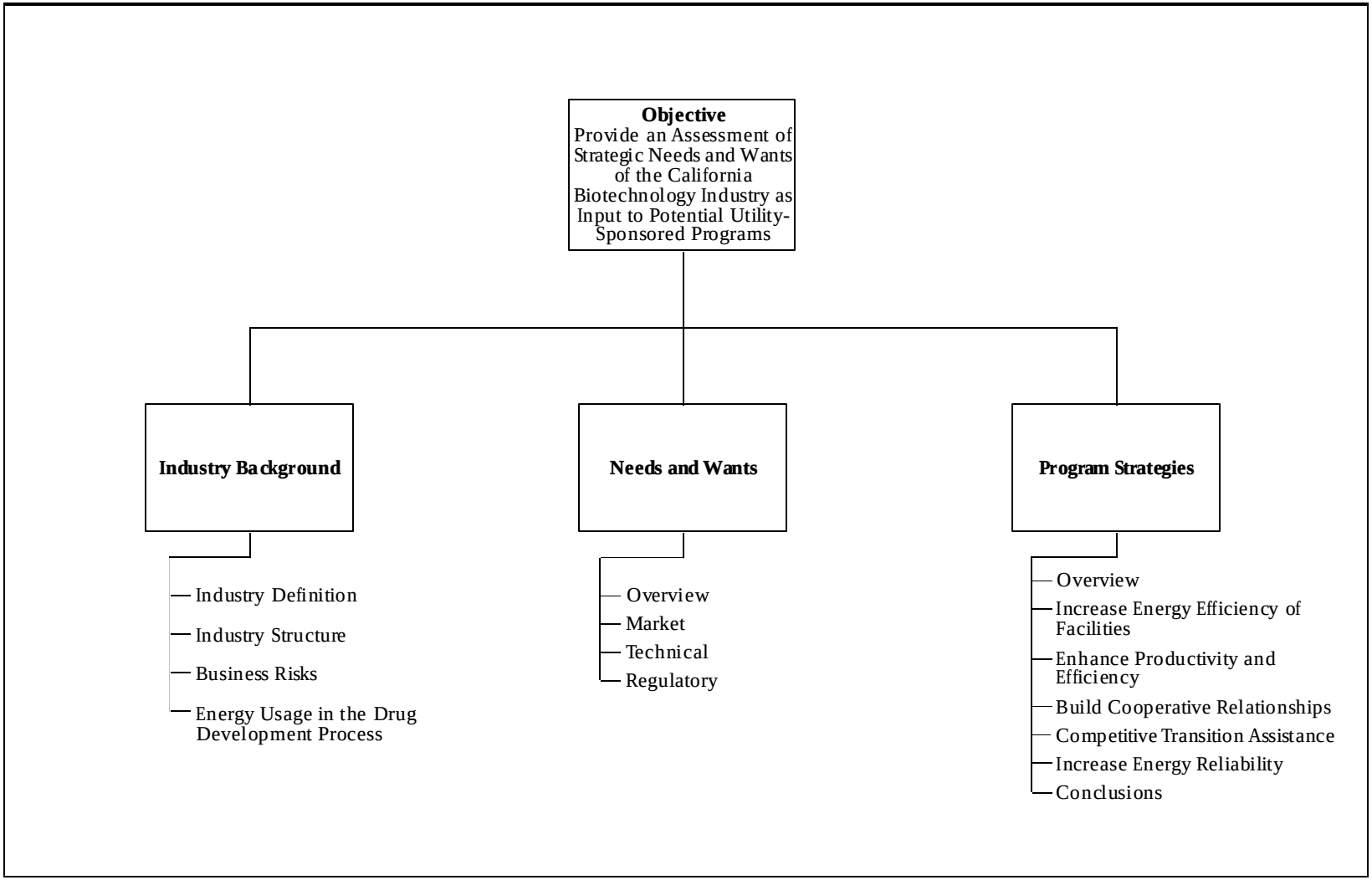
- The biotech industry's ongoing and emerging needs — such as manufacturing expansion, avoiding process interruption — are then discussed.

- Opportunities for utilities to design energy-efficiency programs to meet biotechnology industry needs are presented in the final section. These recommendations are intended to be beneficial to both California's utilities and their biotech industry customers.

This assessment is based on an analysis of the results of a workshop held with six industry experts in October 2000 and a review of secondary sources. Lists of workshop participants and secondary sources are included in the appendix.

[1] Standard & Poor's 2000 Biotechnology Industry Survey.

Exhibit B-1
Assessment of Biotechnology Industry Needs and Wants
As Input to Potential Utility-Sponsored Programs



II. Industry Background

A. Industry Definition

Biotechnology is still a relatively new industry with many broad applications, making the industry's boundaries difficult to delineate.

- One common definition of biotechnology is "the use of living cells and materials to develop and manufacture products used in improving human health, animal health, agriculture and the environment."[2]

  – All living things are made up of cells that are programmed by the same basic genetic material, DNA. Since all living things are made up of the same type of genetic material, scientists use enzymes to cut and remove individual genetic information from one organism and transplant or combine it with another organism. This is called recombinant DNA technology, one of the basic tools of biotechnology.

  – The $300 million field of bioinformatics — one of the highest-growth areas in the biotech field — turns raw genome data into knowledge for making new drugs. Chipmakers and bioscience converge in this new discipline, which applies information technology to genetics and molecular biology.[3]

    .. Researchers are generating large databases containing the details of when and in which tissues of the body various genes are turned on, the shapes of the proteins the genes encode, how these proteins interact with one another, and the role those interactions play in disease.

    .. Bioinformatics offers the prospect of finding better drug targets earlier in the drug development process, reducing the time it takes to research and develop a drug, and significantly decreasing overall costs.

[2] Biotechnology Industry Association, www.bio.org

[3] Ken Howard, "The Bioinformatics Gold Rush," *Scientific American*, July 2000

II.A. Industry Definition (continued)

- Some define biotechnology more narrowly as the processes through which living organisms or their products are modified at the molecular genetic level in order to create products with medical, agricultural and other industrial applications. Other definitions incorporate biotechnology and other life science industries, commercialization into the private sector as well as related medical devices, instruments and software development.[4]
  - The Biotechnology Industry Organization divides the industry into the following areas based on their end-uses: therapeutic, human diagnostics, agricultural, chemical-environmental, and supplier.
    - *Therapeutics*: products that cure or reduce the incidence of disease.
    - *Diagnostics*: products that test for the presence of various health or disease states.
    - *Agricultural*: products related to crop and livestock production, including genetic engineering, veterinary activities, and food processing.
    - *Chemical-environmental*: bacteria have been developed to clean up oil spills and chemical leaks from storage tanks by rendering the hazardous substances harmless, cleaning waste water of harmful chemicals and detoxifying industrial waste at its source.
    - *Suppliers*: specialized materials, equipment or services for other bioindustry firms. Such products include reagents (substances used in chemical reactions), specialized software, and technical instruments for gene splicing.
  - Some industry organizations have added the categories of medical devices and diagnostics, biopharmaceutical, energy production, veterinary, and various combinations of these categories.
    - For instance, the medical diagnostics field has undergone radical transformation due to biotechnology. Biotechnology allows less expensive and more accurate tests for a wide array of diseases, as well as consumer products such as home pregnancy kits. Other definitions are broader, including biomedical science, biotechnology, pharmaceutical, and medical device innovation.

[4] Ross Devol, "Biotech and Bioscience: The 21st Century Cluster Race." The Zone News, January 2000.

- In this assessment (consistent with a recent Ernst & Young study[5]), the biotech industry is defined as companies that are primarily engaged in biotechnology activities using the SIC codes 2833 (medicinal chemicals and botanical products), 2834 (pharmaceutical preparations), 2835 (in vitro and in vivo diagnostic substances), 2836 (biological products, except diagnostic substances) and 8731 (commercial physical and biological research).

  – This assessment focuses on the human therapeutics and diagnostics sectors because they involve 65 to 70 percent of US biotechnology companies. Similarly, California biotechnology firms generally concentrate their activities around human diagnostics, pharmaceuticals, and therapeutic applications.

  – Despite the importance of agriculture to California's economy, the state's biotechnology industry does not appear to emphasize agricultural applications of biotechnology.[6]

[5] Ernst & Young, *The Economic Contributions of the Biotechnology Industry to the US Economy*, May 2000.

[6] Gus A. Koehler, *Bioindustry: A Description of California's Bioindustry and Summary of the Public Issues Affecting Its Development*, Sacramento: California Research Bureau, 1996; www.library.ca.gov/CRB/96/07/BIOT_CH5.html#RTFToC67

II.B. Industry Structure

Although the industry is mostly made up of small and mid-size companies, five large companies claimed one-third of industry revenues in 1998.

- Nearly 1,300 public and private biotech enterprises employed 183,000 workers in the US in 1999. About 30 percent of these firms are located in California, making California the world's leading biotechnology center.[7]

- Biotechnology companies fall into three tiers:

  – Tier One companies are the more established companies with products on the market and in development. The industry's five largest players — Amgen, Biogen, Chiron, Genentech and Genzyme — accounted for about one-third of industry revenues in 1998.

  – The biotech industry consists mainly of second and third tier companies. Tier Two companies are usually not quite profitable but have products that have generated good clinical trial data, whereas Tier Three companies are development-stage pure science organizations. Approximately one-third of biotechs employ less than 50 people and over two-thirds employ less than 135.[8]

- Biotech companies in California are clustered in four major regions: the San Francisco Bay area, Greater Los Angeles, San Diego County, and the Central Valley. These clusters boast major research universities and leading research institutions, a highly skilled labor pool, a large reservoir of industrial experience in computers, pharmaceuticals, medical devices, electronics, and a financing community.[9]

---

[7] Standard & Poor's

[8] Eneida Guzman, "Cowen analyst says biotech has come of age," MSN MoneyCentral, April 29, 1999.

[9] Biotechnology, California Occupational Guide Number 2007 (1996), California Employment Development Department, State of California, www.calmis.ca.gov/file/occguide/biotech.htm

- Academic biomedical research is the bedrock of the biotech industry, according to workshop participants.
  - Technology transfer and faculty-associated company start-ups enhance regional economies.
  - Examples of ambitious collaboration between commercial biotech and 75 California universities and private nonprofit research organizations engaged in biomedical R&D are:
    - The UC-funded BioStar Project promotes commercial collaboration between University of California researchers and healthcare technology businesses.
    - Genentech has partnered with UCSF in building a 43-acre, $1.4 billion satellite campus at Mission Bay dedicated to bioscience research.
    - Netscape founder Jim Clark donated $150 million to create a revolutionary bioengineering center at Stanford. Guidant, a major medical devices company will be an anchor tenant in this venture, according to workshop participants.

II.C. Business Risks

The high failure rate of experimental drugs and regulatory demands contributes to biotechnology industry risks, as medical innovation is a lengthy, risky and costly challenge.

- The complex scientific and regulatory process of bringing a new drug to market results in an inordinately high failure rate. Of approximately 5,000 compounds screened for their potential as new medicines, only one will be approved by the FDA and reach the pharmacy shelf.
- The federal government regulates every step of the development process.
  - Only 5 to 10 percent of drugs entering clinical trials are ultimately approved for marketing.[10]
  - Applications to the FDA for biotech drugs are typically huge documents, sometimes exceeding 100,000 pages. Application to approval takes an average of 18 months.[11]
- It costs $500 million on average to discover and develop one new medicine, according to PhRMA (Pharmaceutical Research and Manufacturers of America).
  - Drug development costs are comprised of lab research and human testing.[12]
  - Preclinical work is estimated to consume about 40 percent of the time and 42 percent of the cost necessary to bring a new compound to market.[13]
- Total development time varies, but on average it takes 12 to 15 years to go from preclinical development to marketing approval.[14]

---

[10] Standard & Poor's, 2000 *Biotechnology Industry Survey*. p. 18

[11] Ibid, p. 19

[12] California Healthcare Institute, "California Healthcare Institute Millennium Report: Report on California's Biomedical R & D Industry

[13] Standard & Poor's, p. 17

II.D. Energy Usage in the Drug Development Process

Energy is required throughout the drug development process to provide the environment needed for successful drug generation, as shown in Exhibit B-2. Although the emphasis of energy usage in R&D and manufacturing differs, each needs abundant, clean water and purified air.

- Water tops the list of important inputs in the biotech product cycle. Abundant and highly purified water must reach standards above that of public water systems.

  – On the R&D side, laboratories need clean steam, de-ionized / reverse osmosis water and water for injection.

  – Biotech manufacturing requires higher water usage than other high tech processes.

    .. "San Diego area biotech firms need an uninterrupted water supply for their future growth and particularly in their move to manufacturing. According to William Rastetter, CEO of Idec Pharmaceutical: "The biopharmaceutical industry needs assurance that there will be adequate water for manufacturing as our companies grow. The demand for our products may increase 35% per year following product launch. If our water usage is frozen at the previous year's level, we'd have to ration our products.'"[15]

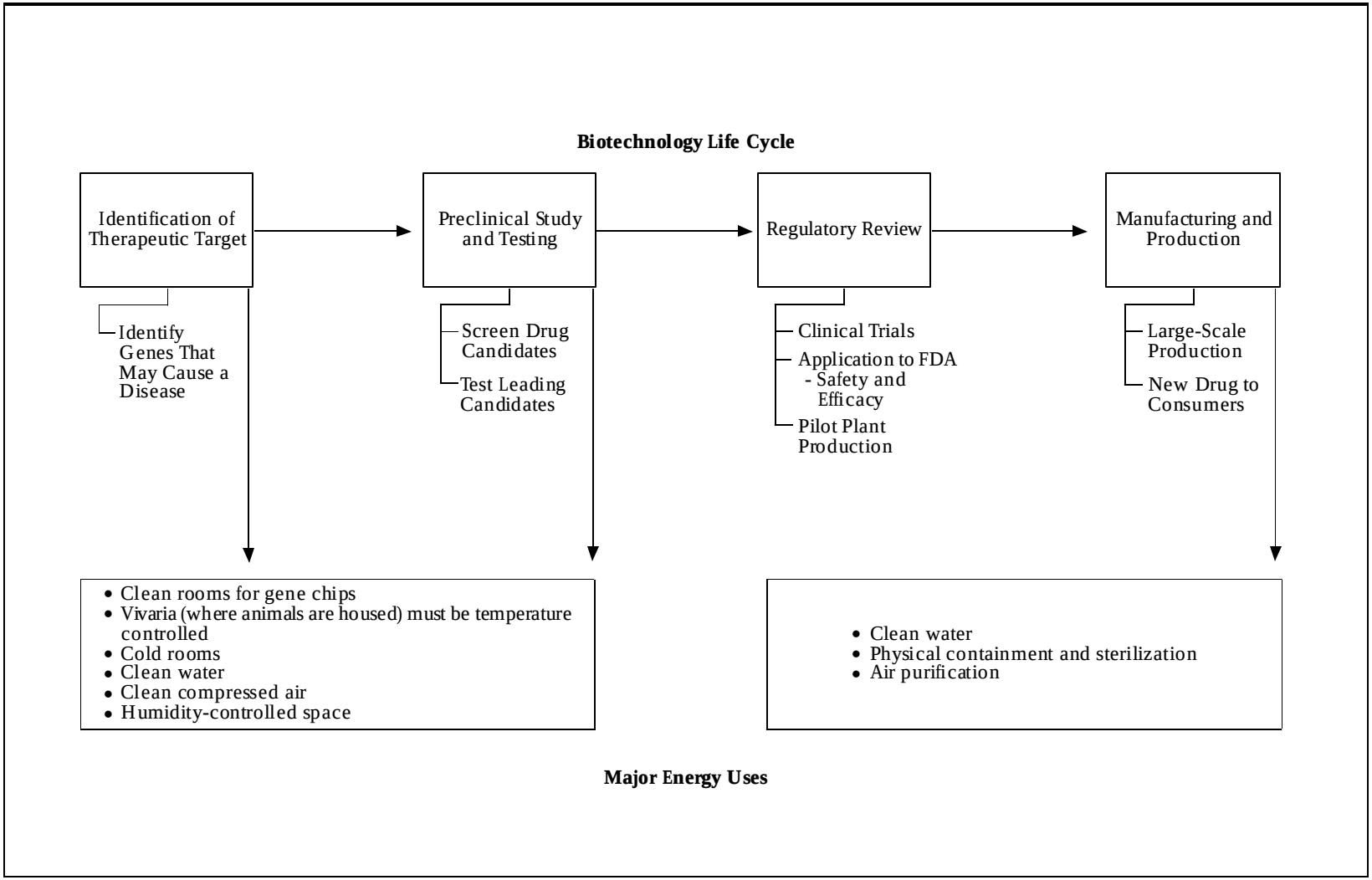
- Clean rooms, vivariums and laboratories require constant air re-circulation. Biotech facilities use HVAC systems with HEPA filtered air for clean compressed air. Fume hoods suck air out constantly, a significant energy impact.

---

[14] Ibid, p. 17

[15] City of Chula Vista, "High-tech / biotech Zone Issue Paper," Revised draft of April 6, 1994; quoted in Koehler, *Bioindustry*

Exhibit B-2
Drug Development Process: Product Cycle and Energy Usage



II.D. Energy Usage in the Drug Development Process (continued)

- Energy usage in biotech laboratories includes:
  - Laboratory equipment — freezers, ovens, incubators, driers, humidifiers, growth changers — all require relatively substantial amounts of energy. Some labs have backup generation in case freezers go offline.
  - Biochemists' traditional wet labs are giving way to computers that search for compounds that bind to and have the desired effect on drug targets. This is the business of gene sequencing companies with terrabytes of genomic data such as Celera. As bioinformatics — "in silico" biology — supplants in vitro lab experiments, companies' energy usage begins to parallel that of the semiconductor industry. Workshop participants noted that Roche Bioscience, whose computers run around the clock, is the largest private user of energy in Palo Alto.
- Biotech products require highly specialized manufacturing facilities and reliable energy.[16] Power interruption can result in adulterated batches, wiping out weeks' worth of product.
  - Physical containment of the manufacturing process (such as fermentation or cell cultures) requires specialized equipment that protects the product, the environment, and the workers.
  - Sterilization is required for equipment entering the containment area and certain processing areas.
  - Air purification systems must restrict airborne particulate matter to designated production and purification areas.

The biotechnology industry's needs and wants are discussed in the next section.

[16] Koehler, 1996

III. Needs and Wants

A. Overview

Some of the biotech industry's needs and wants — managing financial risk and reliable infrastructure supply — have remained the same since the industry's beginning, while others have come to the fore as the industry matures.

- Biotechnology's market needs include more manufacturing capacity, managing financial risk through access to capital and, most recently, an increasing need to manage input costs, including energy.
- The foremost technical need is to avoid biotech process interruption in production facilities. Technical infrastructure needs include a highly trained workforce and reliable, low-cost inputs for biotechs' expanding manufacturing operations. Flexible labs are needed as a cost-effective way of meeting changing research needs.
- The recent election has raised the specter of price controls, a new regulatory burden that could stifle industry growth.

A summary of the biotechnology industry's ongoing and emerging needs and wants is presented next.

Exhibit B-3
Summary of Industry-specific Needs and Wants
Biotechnology Industry

Industry Segments	Industry-specific Needs and Wants									
	Market				Technical				Regulatory	
	Be a Low-Cost Provider	Expand Manufacturing Operations	Manage Financial Risks	Re-establish Market Niche	Obtain Reliable Infrastructure Supply	Avoid Process Interruption	Enhance Productivity	Enhance Flexibility of Production Facilities	Helps Mitigate Regulatory Burdens, Constraints	Seismic Retrofitting Assistance
Semiconductor										
R&D facilities		◒				●	●	◒	◒	
Fabs		◒				●	●	◒	◒	
Foundries	◒	◒				●	●	◒	◒	
Equipment suppliers (toolmakers)		◒				◒	◒			
Biotechnology										
R&D facilities			●		●	◒		◒	◒	
Production facilities	❍	●	●		●	●		◒	◒	
Aerospace										
R&D and New Technology Development	◒		◒	●	●				●	
Assembly	●		◒	●	●				●	
Fruit and Vegetable Processing	●		●		●		◒		●	
Hospitals	●		◒		◒	◒			●	●

KEY
Importance
● High
◒ Moderate
❍ Low

III.B. Market

i. Expand Manufacturing Operations

As the biotech industry matures, more biotech companies will be manufacturing products that pass the clinical trials, creating the possibility of a manufacturing capacity bottleneck.

- Large biotech companies such as Chiron and Genentech need more manufacturing capacity, as well as small biotechs with products in clinical trials or products that have received FDA product approval, according to workshop participants.

- Mechanical and equipment cost elements are the two most significant cost drivers in building biotech manufacturing facilities, due to the expensive infrastructure requirements such as special electrical, exhaust, emergency power and heating, and HVAC systems.[17]

- To meet increasing manufacturing demand, the San Diego Regional Economic Development Corporation, BIOCOM and others are exploring the feasibility of creating a regional technology manufacturing park to accommodate biotech companies' next stages of development.[18]

[17] Richard H. Bender, "Benchmark Costs for Pharmaceutical Facilities," *Pharmaceutical Engineering*, 1996; Rolf Boone, "Seattle Labs Face Severe Space Shortage," *Localbusiness.com*, August 28, 2000

[18] "Biotech Down Under," www.BIOCOM.org

III.B.ii. Manage Financial Risks

Biotech is one of the most research-intensive sectors of the US economy, making access to capital and the management of financial risks musts, especially for newer biotech companies.

- R&D expenditures, which quickly deplete revenues, comprised 53 percent of industry revenues in 1998. The top 5 biotech companies spent an average of $121,400 per employee on R&D in 1998, compared with an average of $31,200 per employee spent by leading pharmaceutical manufacturers.

  – Furthermore, small, undercapitalized firms may not become profitable for several years. Standard & Poor's estimates that less than half of all public biotech companies have sufficient capital to survive two years at current levels of expenditures.

- Companies raised money at a record pace in 2000, but they have been spending more as well, resulting in higher burn rates.[19]

  – Financing is particularly critical to second- and third-tier companies, who need enough cash to fund operations and pay for continuing research and development activities until have product revenue.

  – Venture capitalists traditionally funded much of the early stages of a biotechnology company's growth; Venture funds funneled more than $2.6 billion into private companies by late October 2000. In 1999, the 10-month total was about $935 million.[20] VCs have recently shifted funding into less risky later-stage companies.[21]

---

[19] Burn rate is a widely observed, critical measure of a company's longevity. A company's burn rate is rate at which a new company uses up its venture capital to finance overhead before generating positive cash flow from operations — or how much cash is necessary to keep the business operating from month to month. It is the rate of negative cash flow, usually quoted as a monthly rate. For example, a burn rate of 1 million would mean the company is spending $1 million per month.

[20] Ibid.

[21] Ernst & Young, 1996; Koehler, 1996

- Other funding sources include IPOs, private equity sources, profits from operations, debt, and strategic alliances with other firms and government grants.

  .. The biotech IPO class of 2000 raised nearly $7 billion at the end of October 2000, breaking previous IPO records in both the number of offerings and in the total amount of cash raised (Monsanto's $700 million IPO is not included in this group).[22]

- Large pharmaceutical companies act as the investment bank for the biotech industry (especially when public markets are shut to biotech) through partnering. Corporate partnering, which includes up-front payments and equity investments from large pharmaceutical companies and others, allows biotech companies to stick to their strengths — discovering novel therapeutics and conducting preclinical development — while the pharmaceutical firm leverages its expertise in clinical development, product commercialization and marketing.

[22] Ibid.

III.B.iii. Be a Low Cost Provider

While energy costs have not traditionally been a concern of California's biotech industry, the California energy crisis has put energy cost management on CEO's radar screens, according to workshop participants.

- High energy prices have created the sense among biotech CEOs that energy is something biotechs should manage more carefully, according to workshop participants.

- While lobbying Sacramento to revisit deregulation is a natural response to higher energy costs, workshop participants pointed out that such an approach is not consistent with the biotech industry's opposition to price controls.

- One workshop participant observed that collaboration between supplier and customer, as with any business relationship, is needed to achieve the best result over time.

- Another participant suggested that industry associations could serve their members by engaging the energy issue and collaborating with utilities. A forum can be developed that puts the two industries together to build cooperative instruments that make the market work better from both sides.

Biotechs want to build mutually beneficial relationships with power suppliers, according to workshop participants.

III.C. Technical

i. Avoid Process Interruption

From a research standpoint, interruption of power is inconvenient. From a manufacturing standpoint, it can be devastating.

- Biotech manufacturing processes — from thawing cells to fermentation to recovery — is a continuous three to four week process. Power outages and brownouts may result in adulterated batches, causing biotech manufacturers to write off product lots as complete losses.
  - One major biotech company may consider a cogeneration plant in addition to backup power generation because it cannot afford interruption of its manufacturing processes.
  - Fearing a future of energy shortages and extreme costs in California, large biotechs are taking a serious look at whether to locate new plants "in a place where they screw around with energy costs or in a place with clean, reliable, reliably priced energy," according to one major biotech company that was interviewed.
- While facilities engineers are keenly aware of energy concerns, getting products to market outranks energy efficiency in facility management, according to workshop participants.
  - Energy efficiency (EE) concepts play a key role in design criteria, but workshop participants found EE difficult to sell with short-term capital.
  - Previous utility incentive programs once put EE higher on radar screen, according to participants. Sizeable utility rebates got one major biotech "over the hump" with corporate management in new construction. Another large biotech company has EE habits — energy-efficient motors, double-paned windows, energy-efficient lighting — but, according to a workshop participant, EE isn't a big driver without ongoing utility programs for energy savings.

III.C.ii. Obtain Reliable Infrastructure Supply

a. Labor

Biotechnology companies require a highly trained workforce. The supply of workers with the necessary skills and education has not kept pace with industry's dramatic expansion in the 1990s.

- The convergence of chipmakers and biosciences puts biotech squarely in the high-tech sector, competing with the computer industry for high-quality information technology staff. Moreover, the bioinformatics workforce must know both biology as well as computer science.

- Demand for R&D staff is not likely to increase significantly, while thousands of job opportunities in production and commercial manufacturing activities will be created as many products pass clinical trials and regulatory approvals.[23]

- Biotech is such a fast-moving industry that universities are behind the curve in training workers for biotechnology occupations, according to workshop participants.
  - Participants pointed to a few progressive schools, which have created programs that are relevant to the industry, such as Cal State Hayward's biotech laboratory technician training and San Diego State's regulatory affairs certificate, but noted that many others are conservative in their approach to the industry.
  - Similar to the experiences of other high-tech sectors, there are too few qualified US workers to go around, as fewer US students are choosing scientific and technical careers. As a result, biotech businesses look overseas for skilled workers. The annual cap on H-1B visas will continue to be a workforce issue for the industry.

- Labor shortages affect peripheral industries as well. Some lab designers, engineering firms and contractors that build biotech facilities cannot staff jobs, according to participants.

[23] Biotechnology, California Occupational Guide Number 2007 (1996); California Employment Development Department

III.C.ii.b. Inputs

According to workshop participants, in deciding where to locate new manufacturing facilities, large biotechs are considering states that are more manufacturing-friendly than California — states where costs of inputs are lower, regulations are less burdensome, and energy is perceived as reliable and reliably priced.

- Workshop participants' views support a recent A.T. Kearney study that finds that other regions outrank California in meeting biotechs' operational needs. Kearney asked senior executives at 40 biotechnology, pharmaceutical, and medical-device companies to rate 8 regions on 12 site-selection criteria. The study concluded that young firms find the resource infrastructure to be most important while maturing companies rely more heavily upon operational sustainability in site locations.[24] The top three regions are:

Resource infrastructure factors	Operational sustainability factors
1. Boston, MA	1. North Carolina
2. San Francisco, CA	2. Austin, TX
3. Bay Area (CA)	3. San Diego, CA

- Other regions are recruiting mature biotechnology firms to build manufacturing facilities. According to workshop participants, Texas has played the water card — ample water forever, basically free; North Carolina offers lots of inexpensive land; and Phoenix's loose environmental standards appeal to biotech manufacturing operations.

- As discussed above, California's energy outlook — reliability, volatility, cost — now factors into biotech companies' manufacturing expansion, according to workshop participants. While companies like Chiron and Genentech started in the Bay Area, their manufacturing facilities are now in Vacaville, CA — which offers green space, is more manufacturing friendly and cheaper to operate. Biotechs are now asking whether they can continue to operate in California — companies are asking questions such as: why not manufacture products in Kentucky or Tennessee?

[24] www.zonecommunications.com/jan00/biotechscience.html

III.C.iii. Enhance Flexibility of Production Facilities

R&D facilities are constantly remodeled to meet changing scientific needs and equipment. Adaptable, flexible labs meet the demands of a dynamic research program and reduce the need for expensive renovation and retrofitting.

- Lab work is characterized by high equipment densities and increasing reliance on instrumentation and robotics, creating frequent changes in the use of space and the role of research space.
  - Novartis is changing the design of its new San Diego facility, after already breaking ground, to accommodate new science and new technology, according to workshop participants.
  - Utility systems are critical to successful lab operation. The building infrastructure must support and complement the lab module, meaning that all building systems (i.e., compressed air, pure water) must be set up to work within the lab module. Malfunctions can dramatically impact lab productivity. In addition, mechanical/electrical/plumbing (MEP) systems account for as much as half the cost of a lab building.[25]
- Standardized designs mean that the facility is reusable, which is attractive to investors. The Association of Biotech Companies has adopted standards developed by The Nielsen Capital Group for single-tenant start-up bio-pharmaceutical research and development facilities.[26]
- Amgen recognized the operational advantages of generic labs and established standards to make new lab facilities more flexible.[27]
  - Extensive studies of its existing lab facilities revealed that excessive customization, fixed casework and non-standard utility schemes resulted in expensive renovations and lost productivity when Amgen's science staff changed or new equipment was brought in.
  - Amgen sought a consistent modular layout that adapted to changing scientific needs — generic labs, flexible casework and a disciplined MEP systems layout.
  - Amgen planners also incorporated commissioning from the outset to ensure successful start-up.

---

[25] "Amgen Benchmarks to Plan its Future Building 29," *FM Data Monthly*, October 1997; see also Bender, 1996

[26] Koehler, *Bioindustry*, fn 139

[27] *FM Data Monthly*, 1997

III.D. Regulatory

i. Mitigate Regulatory Burdens, Constraints

The industry fears that price controls on prescription drugs choke industry growth by limiting profits, investment in biotech companies and innovation.

Political anxiety about drug costs ultimately translates into cost pressure to biotech and the pharmaceutical industries, according to workshop participants.

- As government representatives look for ways to keep Medicare solvent and to expand prescription drug benefits for senior citizens, the health care industry fears that government-imposed price controls on breakthrough drugs may be part of the equation. The industry fears that price controls will limit profits, thus stifling investment in biotech companies and choking the drug pipeline.[28]

- Maine established price ceilings for prescription drugs in May 2000; other states may follow suit.[29]

Opportunities for utility programs to jointly meet its needs and the needs of its biotechnology industry customers are discussed in the next section.

---

[28] Carl B. Feldbaum, "Price Controls Could be Lethal to Biotech," *The Boston Globe*, April 20, 1999; see also Joseph Panetta, "Price Controls on Prescription Drugs — A Disincentive to Biopharmaceutical Growth," www.biocom.org/Commentary005.html

[29] "Maine Enacts Drug Price Controls," Impact Report, Tufts Center for the Study of Drug Development, July/August 2000). www.tufts.edu/med/research/csdd/impact10.pdf

IV. Program Strategies

A. Overview

There are several promising opportunities for California's utilities to assist the biotechnology industry in meeting some of its most important needs. These opportunities include:

- Increasing energy efficiency of facilities, especially new manufacturing plants, by helping facility managers make the business case for energy savings opportunities and supporting building commissioning.
- Enhancing productivity and efficiency by assisting in the design of efficient manufacturing facilities and modular lab design.
- Forming relationships with industry organizations as a vehicle for collaborating on energy issues. As one workshop participant observed, collaboration between supplier and customer, as with any business relationship, is needed to achieve the best result over time.
- Providing competitive transition assistance—market intelligence on California's energy outlook and financial instruments for managing risk.
- Increasing energy reliability through load management and distributed generation.

Each recommendation is discussed in more detail below.

Exhibit B-4
Biotechnology Industry Needs and Wants Program Selection Matrix

Recommendations	Selection Criteria: Industry Related Needs and Wants — Market: Be a Low-Cost Provider	Market: Expand Manufacturing Operations	Market: Manage Financial Risks	Market: Re-establish Market Niche	Technical: Obtain Reliable Infrastructure Supply	Technical: Avoid Process Interruption	Technical: Enhance Productivity	Technical: Enhance Flexibility of Production Facilities	Regulatory: Mitigate Regulatory Burdens, Constraints	Regulatory: Seismic Retrofitting Assistance
INCREASE ENERGY EFFICIENCY OF FACILITIES										
Support ESCO Activities Attuned to Industry Needs			○		●		○	◒		
Streamline SPC Process									◒	
Educate Facility Managers re Business Case Presentations			○							
Support Building Commissioning		◒						◒		
Support Open Architecture for Metering, Submetering		○						◒		
ENHANCE PRODUCTIVITY AND EFFICIENCY										
R&D Collaboration										
Industry-specific Demonstrations and Case Studies		◒					◒			
Design Assistance		●						◒		
BUILD COOPERATIVE RELATIONSHIPS										
Partnerships between Industries and Utilities	◒				●	●			●	
COMPETITIVE TRANSITION ASSISTANCE										
Advice to Industry about California Energy Market	●		◒		●	●			●	
Financial Instruments to Manage Energy Price Risks	●		◒		●				●	
INCREASE ENERGY RELIABILITY										
Load Management					◒	◒				
Funding for Distributed Generation and Cogeneration					●	◒				

KEY
Relevance
● High
◒ Medium
○ Low

IV.B. Increase Energy Efficiency of Facilities

i. Business Case Presentations

Ongoing renovations in R&D facilities and manufacturing expansion are creating opportunities for utilities to facilitate energy retrofits, but these opportunities must be presented persuasively to corporate management.

Manufacturing expansion and elevation of energy concerns to the CEO level offers a timely opportunity to assist energy-knowledgeable facility managers in encouraging the design of energy-efficient biotech buildings.

- Utilities can conduct energy studies to help facilities managers sell energy savings opportunities in lab retrofits and new construction to corporate management.

- Utilities can help facilities managers document operational successes and cost savings through participation in utility programs that are geared to the needs of the biotech industry.

IV.B.ii. Building Commissioning

Utilities can encourage more widespread building commissioning and retrocommissioning, particularly in manufacturing facilities.

In the past, commissioning was bypassed in the rush to begin utilizing a facility. Commissioning is now penetrating the R&D side; companies find it valuable in ensuring successful start-up.

- Commissioning is becoming part of the process for starting up new manufacturing facilities, according to workshop participants. FDA regulations and validation require a rigorous commissioning process. Retrocommissioning can also be beneficial.

- Larger biotech companies are more likely to be receptive than startups with a short time horizon that are operating in survival mode.

IV.C. Enhance Productivity and Efficiency

i. Design Assistance

Utilities could offer design assistance as a way to support biotech's desire for generic labs as it matures into a more standardized manufacturing industry.

- Utilities can help meet biotech's need for generic labs by helping to design standardized, energy efficient utility system for research labs.
  - Utility systems are critical to lab operation. Utilities can play a role in designing modular utility systems that are energy efficient as well as robust and cost-effective.
  - Workshop participants suggested that utilities could best influence lab design upstream in the design / build process, because architects know little about energy efficiency.
- Manufacturing expansion offers an opportunity for utilities to help design an energy-efficient manufacturing model. Workshop participants expressed interest in a modular manufacturing facility, but acknowledged that different bioprocesses make it difficult to build "one size fits all" plant.

IV.D. Build Cooperative Relationships

i. Partnerships

Collaborative relationships with industry organizations — beginning with an ongoing forum for dialogue — are mutually beneficial to biotech customers and the utilities.

- The biotech industry would welcome contact with utilities, according to participants.
  - An industry association could serve as an excellent organizing mechanism for a structured conversation over time that productively engages biotech's energy concerns.
  - An industry association can be a transmission vehicle for utilities to demonstrate the benefits of energy efficiency to data/finance/science-driven biotech people through demonstration projects and case studies.
- Utilities could contribute to an industry-led energy benchmarking initiative. According to workshop participants, it would be valuable to look externally as well as internally in benchmarking energy costs.
- Partnering with an industry association would help utilities target the different needs of biotech customers. For example, startups in survival mode may be more concerned with initial cost than large biotechs that plan longer term. Startups may favor value engineering over more efficient facilities — which are more expensive to build but save energy in the long run — because startups don't know that they'll be operating five years down the road.
  - An industry association-utility partnership could focus on helping second and third tier companies come to grips with managing their energy costs. Startups — focused on managing the money and the science, not input costs — may not have the management experience or procurement sophistication to manage their energy beyond paying their bills.
  - Another initiative could target the construction needs of more mature biotechnology companies through energy-efficient modular lab and manufacturing designs.

IV.E. Competitive Transition Assistance

i. Advice on CA Energy Market

Utilities should provide the biotech industry with clear, concise and accurate information about changes in California market, future electricity reliability and cost through high-level interactions between utility and biotech industry leaders.

- This could include commissioning a group of energy experts to conduct a study of California's energy future. Presenting the results of a risk assessment of likely electricity supply and cost outcomes to biotech industry leaders would be most useful.
- Market intelligence is particularly critical for companies preparing for manufacturing expansion, as California's energy infrastructure factors into their strategic planning.
- Presenting the results of a risk assessment of likely electricity supply and cost outcomes to biotech industry leaders would be valuable input on future electricity reliability and supply issues.

Once the volatility is dealt with, the prevailing message from large biotech customers is uncertainty — about energy reliability, cost and infrastructure. The biotech industry needs good information on the current and future outlook of the electricity system. Utilities can allay their concerns with clear, concise information about the future of California's electricity market.

IV.E.ii. Manage Energy Price Risks

Utilities should consider assisting the biotech industry in building a portfolio of financial instruments for managing energy risk exposure and the impacts of price volatility.

- The biotech community is familiar with sophisticated financial instruments — financing is their lifeblood — and may welcome utility-sponsored workshops on hedging energy price risks through futures and options, swaps and insurance policies.

- Assistance in hedging energy price may offer the greatest benefit to smaller companies without sophisticated energy managers who do little more than pay their bills, according to workshop participants.

IV.F. Increase Energy Reliability

i. Load Management and Distributed Generation

Utility-sponsored load management, distributed generation and cogeneration initiatives could enhance the reliability of biotech facilities and California's electricity grid, while contributing to statewide energy conservation.

As discussed in the previous section, a reliable energy supply is critical to a viable biotechnology industry. The industry would benefit greatly from programs that provide direct benefits to the industry and contribute to enhancing the reliability of California's electricity supply (from both an availability and cost perspective).

- Load management programs that provide financial benefits to biotech industry customers and, at the same time, assist in addressing California's peak demand issues would be beneficial to both the biotech industry and the California IOUs. Re-examination, and possible expansion of existing programs, as well as the adoption of new programs, is strongly recommended.

- Biotech companies with very low tolerance for supply risk may invest heavily in physical backup capability such as backup supply, demand management capabilities, distributed generation.

  – These end users can develop alternate fuel capability and switch when prices are favorable, develop storage capability (for fuel or gas) and fill during low price periods, develop self-generation at known price levels, develop operating flexibility to access lower-priced supplies, and develop cost-effective, hands-on energy management techniques.

  – Innovative distributed generation and cogeneration programs (such as the pooled demand programs offered by utilities in the Midwest) could be considered by some utilities. These programs, if properly designed and implemented, could help meet the reliability needs of both the utilities and biotech industry customers.

IV.G. Conclusions

The workshop surfaced two primary issues regarding industry relationships with California's utilities and their implications for future energy efficiency initiatives. First, the industry is gearing for major manufacturing growth, with accompanying opportunities for energy efficient new construction. However, some of the manufacturing growth envisioned for California may move out of state due in part to energy concerns. Second, biotechs want to engage utilities in an ongoing conversation about energy issues.

- California's biotechnology industry is at a crossroads.
  - While its biomedical research assets have made California the world's headquarters for biotech research and development, corporate planners are considering other regions for manufacturing plants as biotech matures into a manufacturing industry.
  - According to workshop participants, California's energy crisis may compromise the operational sustainability of biotech manufacturing in California.
- The biotech industry wants to engage utilities in an ongoing conversation, presenting a timely and promising opportunity for proactive collaboration. Biotech industry organizations offer a vehicle by which utilities can reassure and inform biotech customers about energy issues, including the role of energy efficiency and load management, and help California sustain its leadership in commercial biotechnology.

The biotechnology industry has been awakened to energy and energy efficiency/load management issues by the turbulence in California's energy market, as energy reliability and cost directly affect biotech companies' bottom line. The current state of California's energy market calls for broad and novel thinking about how to respond to the voice of these customers.

C. AEROSPACE INDUSTRY ASSESSMENT

I. Introduction

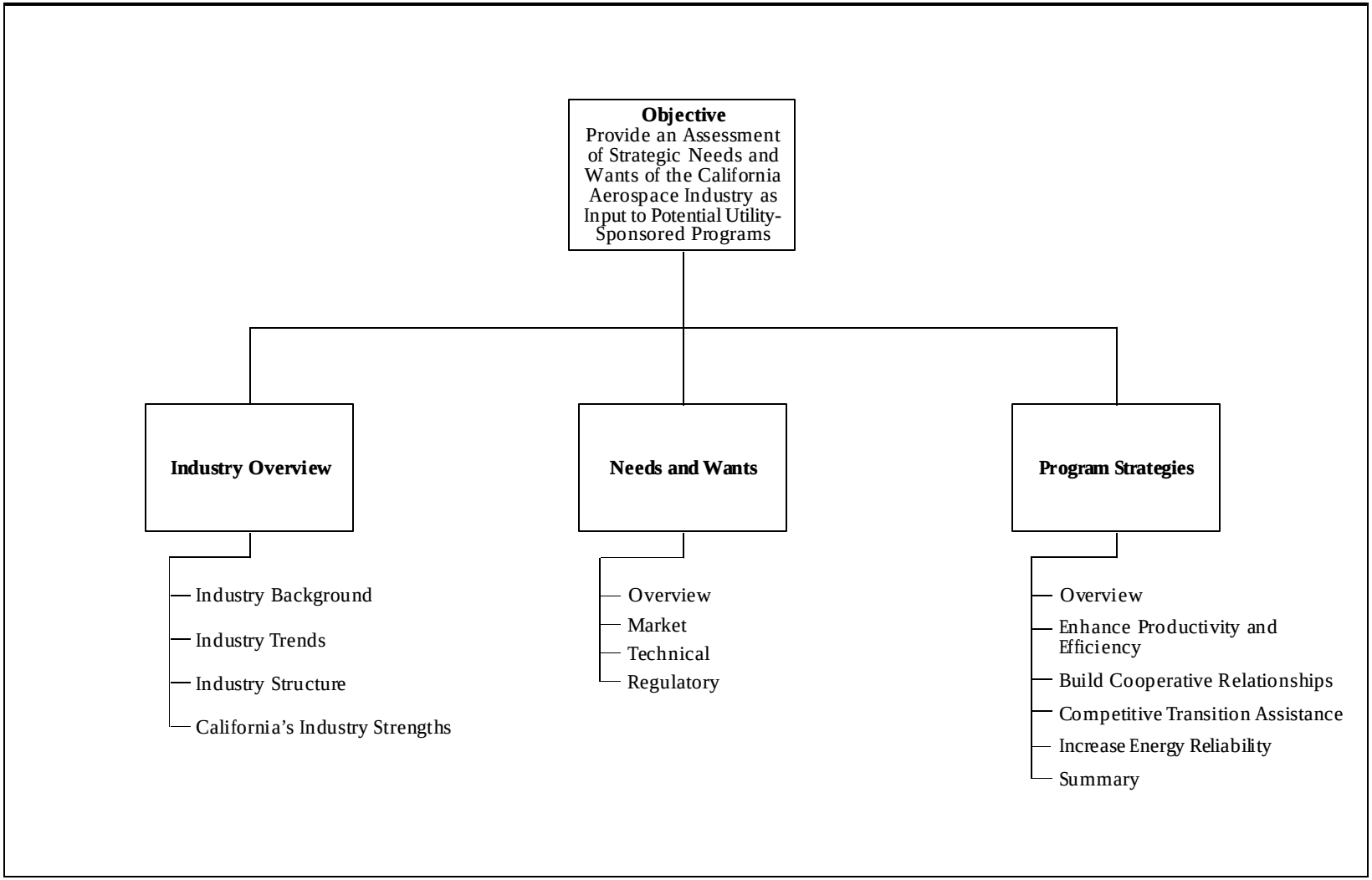
This chapter provides an assessment of the strategic needs and wants of California's aerospace industry as input into potential utility-sponsored energy-efficiency programs for California's large customers.

An overview of the chapter's contents is presented in Exhibit C-1 and summarized below.

- To set the stage for the description of aerospace industry's needs and wants, the chapter begins with an overview of California's aerospace industry.
- The market, infrastructure, and regulatory needs of the aerospace industry are then discussed, with special emphasis on the threats and opportunities facing the aerospace industry in California.
- Opportunities for utilities to design energy-efficiency programs to meet aerospace industry needs are presented in the final section. These recommendations are intended to be beneficial to both California's utilities and their aerospace industry customers.

This assessment is based on an analysis of the results of a workshop held with six industry experts in July 2000 and a review of secondary sources. Lists of workshop participants and secondary sources are included in Appendix B.

Exhibit C-1
Assessment of Aerospace Industry Needs and Wants
As Input to Potential Utility-Sponsored Programs



II. Industry Overview

A. Industry Background

The California aerospace industry is in the process of developing a new business model, new relationships, and new funding sources to counteract industry downsizing and shrinking market share.

- Aerospace is one of California's largest industries, but, according to some workshop participants, state government officials treat it like a "poor relation."
  - There are over 40,000 firms in California's aerospace industry.
  - The six largest aerospace companies provide over 130,000 California jobs. For example, one recent publication indicates that the largest aerospace firms (those with greater than 1,000 employees) account for 3.6 percent of the firms in the industry, but account for 70 percent of the employees.
  - According to workshop participants, Boeing is one of the largest employers in the state.
- Annual electricity bills of major plants were over $100 million 15 years ago and are about a billion dollars today.
- California aerospace firms accounted for 40 percent of Federal government contracts in 1986, but that share decreased to 20 percent in 1996 due to the shrinking defense budget and the shift of production to other states.
  - The Los Angeles aerospace industry payroll, for example, fell from $4.65 billion to $2.09 billion between 1987 and 1996, according to the 1998 South Bay Economic Adjustment Strategy.
  - In their heyday, most aerospace companies were headquartered in southern California. Now, only one major aerospace firm (Northrop Grumman) is currently headquartered in California.

II.B. Industry Trends

According to Standard & Poor's, the aerospace industry outlook is mixed — the satellite- and rocket-making industries are growing rapidly, but defense spending is stagnant and the production boom in commercial aircraft is ending. Non-aerospace activities are, however, growing.

Exhibit C-2 contains Aerospace Industries Association data for the period 1988-1998. Updates through 2000 are included in the discussion below.

- The commercial space business, which is important in California and generally consists of satellite manufacturing, ground support equipment/services and rocket-making/launch services, has grown by 20 percent annually over the last decade and is expected to continue to grow, primarily due to increases in demand from satellite-based providers of telecommunications, video, tracking and Internet services. Note that this trend is consistent with growth in the space and non-aerospace segments presented.

- After a downturn over the decade ending in 1998, US military spending is growing at modest rates, but it is not expected to reach previous levels.

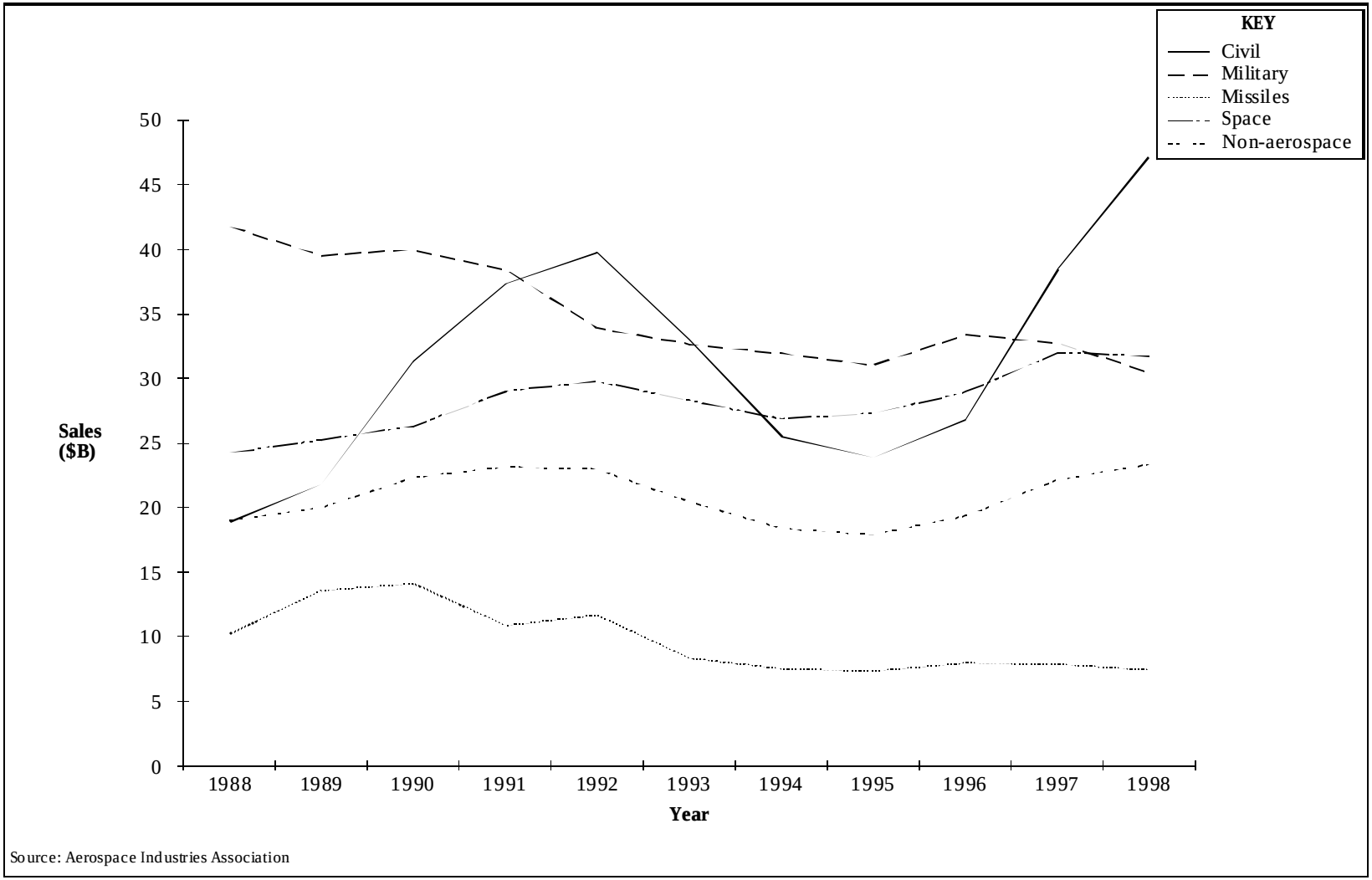
- US government defense spending, the aerospace industry's primary demand driver, grew 4.7 percent to $268 billion for fiscal 2000. Standard & Poor's expects modest (1 to 3 percent) growth over the next decade.

  – European defense industry consolidation could, according to Standard & Poor's, increase competition in the international arms market, which is more profitable for US companies than sales to the Pentagon.

- The boom in orders and production of commercial aircraft has peaked, and profit margins are relatively low. Important commercial aircraft assembly operations remaining in California include the Boeing 747 fuselage in Hawthorne and the Boeing 717 in Long Beach.

- Non-aerospace activities continued to grow in 2000.

Exhibit C-2
Sales of the Aerospace Industry by Product, 1988-1998



Source: Aerospace Industries Association

II.C. Industry Structure

Prime contractors, subcontractors and suppliers have all consolidated in response to industry downsizing and shrinking market share, creating a more stratified market structure.

- According to workshop participants, prime contractors — the major aerospace manufacturers with a full systems-integration capability — received approximately $20 billion in funding from the US government in the past year. 50 to 70 percent of these funds are allocated to subcontractors (who, in some instances, are prime contractors for other projects). While subs are not the largest aerospace firms, they are awarded the bulk of the industry's federal contract dollars and make up a significant fraction of firms in the industry.

- Suppliers, rather than prime contractors, may become the focal point of R&D and new technology development — two of California's strengths — in the years ahead.

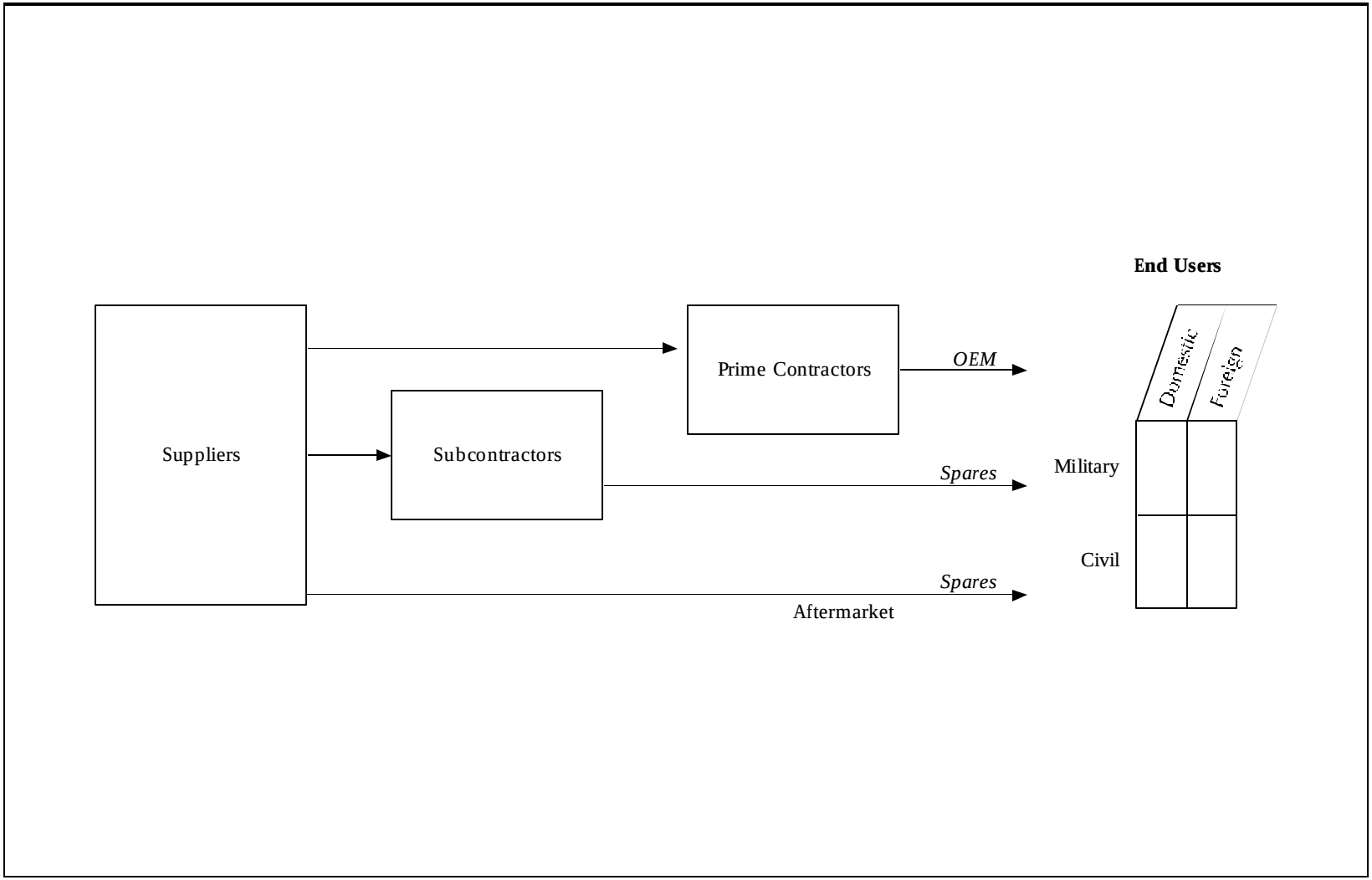
  – Prime contractors are outsourcing more R&D to suppliers in order to cut costs.

  – Primes are concentrating their purchases on a much smaller number of high-quality suppliers, increasing their importance in the aerospace marketplace.

  – The relative geographic location of primes to subs is a major factor in risk and cost reduction.

The aerospace industry structure — shown in Exhibit C-3 — serves both military and civilian markets. Those markets, which have undergone significant change in recent years, are discussed in the next section.

Exhibit C-3
Aerospace Industry Structure



II.D. California's Aerospace Industry Strengths

California's strengths lie in development and high technology applications more than assembly line production.

- Production programs are being transferred out of state, but California maintains an advantage in developmental programs. Workshop participants observed that if production leaves, so do the funding and resources for development.

- Production is more capital intensive than R&D, but the latter is more risky and faces more uncertain funding.

- According to workshop participants, developmental programs are in jeopardy because:

  – Lead times for government-related aerospace development have lengthened (10-15 years to product completion), and funding for long-term programs is more and more difficult to obtain in the post-Cold War environment.

  – Moreover, long-term product plans do not square with year-by-year government funding; this is further complicated by electoral turnover among officials.

  – Total funding for industrial R&D in the aerospace industry has declined sharply since 1988; the industry is increasingly focused on short-term research and product development.

Development and commercialization activities will continue to be important in California. Although the future is uncertain, regeneration and expansion is possible. This industry overview sets the stage for the following discussion of aerospace industry needs.

III. Needs and Wants

A. Overview

The California aerospace industry's needs fall into three broad categories — market, infrastructure, and regulatory.

- Market needs — California can re-establish market share by leveraging its technology leadership.
- Technical needs — Reliable energy and labor supplies are vital parts of a reliable infrastructure.
- Regulatory needs — Stringent regulations threaten California's global competitiveness.

A summary of the aerospace industry's market, technical, and regulatory needs is presented next.

Exhibit C-4
Summary of Industry-specific Needs and Wants
Aerospace Industry

Industry Segments	Industry-specific Needs and Wants									
	Market				Technical				Regulatory	
	Be a Low-Cost Provider	Expand Manufacturing Operations	Manage Financial Risks	Re-establish Market Niche	Obtain Reliable Infrastructure Supply	Avoid Process Interruption	Enhance Productivity	Enhance Flexibility of Production Facilities	Helps Mitigate Regulatory Burdens, Constraints	Seismic Retrofitting Assistance
Semiconductor										
R&D facilities		◒				●	●	◒	◒	
Fabs		◒				●	●	◒	◒	
Foundries	◒	◒				●	●	◒	◒	
Equipment suppliers (toolmakers)		◒				◒	◒			
Biotechnology										
R&D facilities			●		●	◒		◒	◒	
Production facilities	○	●	●		●	●		◒	◒	
Aerospace										
R&D and New Technology Development	◒		◒	●	●				●	
Assembly	●		◒	●	●				●	
Fruit and Vegetable Processing	●		●		●		◒		●	
Hospitals	●		◒		◒	◒			●	●

KEY
Importance
● High
◒ Moderate
○ Low

III.B. Market

i. Re-Establish Market Niche

a. Develop Commercially Viable Products

Budget constraints and government turnover highlight the need for continued commercialization of aerospace industry products.

- As indicated in Exhibit C-3, commercial aerospace industry revenues became the largest segment of the aerospace industry in 1997.
- Government projects, as well as private/commercial projects, must be commercially viable because of increasing risk in the tight and uncertain US government market. As a result, risk management is becoming increasingly important.
  - In the past, the paradigm in government contracts was "sell then develop;" now it is "develop then sell" — the new paradigm demands substantial up-front investment, making projects more expensive and more risky than they have been in the past.
  - Government funding is year-to-year; the government's attitude about the need for a product can change almost overnight due to the ever-changing political situation. This can lead to dramatic cost-per-unit increases or even cancellation of the program altogether, after years of product development.
  - There are fewer bidders and fewer programs primarily due to the smaller defense budget.
- Evolving industry responses to the changing market environment include:
  - Changing business models to keep up with general market changes.
  - Altering business structures to attract California workers from other high demand areas (for example, design and run high tech facilities according to the "dot com" model rather than maintain typical manufacturing facilities, which are based on the government-contract-oriented facilities).
  - Developing innovative products as part of government projects that can be put to commercial use.

III.B.i.b. Leverage California's Technology Strengths

California's aerospace industry can capture more aerospace business by leveraging its technology strengths to meet sustained commercial demand — in defense technologies, global positioning and communications satellites, and telecommunications.

- The high technology sector may be the key to attracting and retaining aerospace business.
  - California's high technology sector (computers, electronics, instruments, high technology services, satellite communications) is a cluster of industries linked to space systems, aeronautical services and aviation.
  - Its high tech output includes R&D services as well as electronic and aerospace hardware and software.
- California has 60 percent of the global satellite manufacturing market, a $12 billion business expected to grow to over $15 billion by 2001.
  - The commercial space business (satellite manufacturing, ground support/equipment/services, rocket-making/launch services) has grown by 20 percent annually over the last decade.
  - The growing number of new satellite-based service outfits, such as digital television and radio, paging, mobile phone, and broadband Internet services, has spurred the strong demand for commercial space products.
  - Commercial customers accounted for half of satellite manufacturing and launch service revenues in 1998, according to the Satellite Industry Association. Hughes DirecTV is a good example of a successful commercial application in which satellite technology was brought to the consumer market.

Commercial innovation cannot be considered separately from cost. The next section discusses cost drivers in the California aerospace industry.

III.B.ii. Be A Low-Cost Provider

Cost, and, to a certain extent, political pressure drive assembly plant siting decisions.

- According to workshop participants, once production operations go out of state, they are unlikely to return. If production is relocated overseas, it is highly unlikely to ever return.
- The low-cost (or lowest-cost) qualified bidder wins government contracts.
  - The low bid, which is no longer in California, typically wins production programs.
  - Complicating this low-cost structure is the decline in the number of programs.

III.B.ii.a. Low-Cost Labor

Labor cost is an important factor in aerospace siting decisions.

- Labor represents approximately 30 percent of aerospace production costs, according to mid-1980s US Department of Census data.
- Cost-reduction strategies include:
  - Offer low salaries and benefits and accept the risk of more mistakes.
  - Increase training and pay higher salaries, and develop modern technology to make fewer mistakes.
    - This is California's primary option due to the need to pay high wages to retain its high-skilled workforce.
    - According to workshop participants, California and Washington State are the largest and most expensive states for Boeing business.
- California's intellectual capital helps retain aerospace ventures, an asset that is factored into siting decisions.

Due to the need to pay high wages to retain the workforce, superior technology is one of California's best options for retaining aerospace business. Energy costs, discussed next, are also a significant part of the cost structure.

III.B.ii.b. Energy

Reducing electricity cost by itself will not help aerospace companies win major government contracts, but reducing these costs will make contracts more profitable.

Energy costs are a small component of total production costs, but energy is the major component of use and occupancy (U&O) costs.

- In an industry where profit margins are tight, energy savings are a major concern of facility managers.
- This is evidenced by the fact that most of Southern California Edison's large aerospace industry customers participate in Edison's interruptible rate program. As discussed in more detail in the next section, participation in this program is being reevaluated given recent curtailments.
- In addition, different energy service providers (ESPs) approached the aerospace industry prior to deregulation, but the number of offers has dropped significantly. A number of California's aerospace industry firms do not currently have contracts with non-utility ESPs.

III.B.ii.c. Competition with Other States

State governments can have strong influences on aerospace siting decisions.

- States compete on creative cost reduction and public sector efficiencies in attracting and retaining aerospace companies and space ventures.
  - Alabama, for example, recently attracted 3,000 aerospace manufacturing jobs with over $100 million in workforce training and tax incentives, beating out both California and Florida.
  - Mississippi has used taxes from gambling to offer similar incentives.
- California can retain developmental industry and local facilities if the state sponsors strategic economic policies. In developing these policies, it is important to keep in mind that corporations are global and are loyal to their shareholders more so than to any one specific state.
  - Production-oriented programs are awarded to the lowest cost facility, even if this means closing down an existing facility in one state and opening a new facility in another state.
  - The industry's lobbying is conducted at the Federal (not state) government level. At the Federal level, the issue of siting becomes politicized because senators and representatives want to keep / attract jobs in their states.
- States can also negatively influence the aerospace industry through undue bureaucracy, regulatory burdens and the tax structure.

III.B.ii.d. Existing Local Assets

There are many unique facilities left in California, but some local plants are endangered.

- To cite a few examples:
  - Federal assets such as NASA Ames Research Center and NASA's Jet Propulsion Laboratory offer state-of-the-art science and research.
  - Several of the world's most sophisticated and largest satellite manufacturing plants are located in California.
  - Vandenberg Air Force base is a premier US space launch site.
- But more and more highly specialized facilities (radar sites, for example) have been closed because keeping them is not economically justifiable.
  - Some satellite, aircraft, and spacecraft assembly / testing plants are migrating to other states and abroad, at least in part because overseas contracts require that part of the work is done in the buyer's country.
  - According to workshop participants, keeping the remaining Air Force bases in California is very important to the state's aerospace industry (Edwards AFB, for example, provides state-of-the-art aerospace research, development, test and evaluation support to space missions).

The industry's need for reliable infrastructure supply is discussed in the next section.

III.C. Technical

i. Obtain Reliable Infrastructure Supply

a. Energy

Reliable infrastructure is very important to the aerospace industry in all areas, and especially in high tech applications. The lack of a reliable infrastructure could be the critical factor that results in the loss of a government contract.

With regard to electricity in particular, electricity cost containment is important, but not as critical as enhancing reliability and increasing productivity.

- As discussed in the previous section, energy costs account for a low percentage of total production costs, but the cost of not having reliable energy is very high. To cite one example, power interruptions can have significant cost impacts on a testing procedure that is scheduled to last 30 days. Such power interruptions can mean costly delays that may compromise their delivery schedule, possibly jeopardizing their ability to win future contracts.

- Many of California's aerospace companies are reconsidering their participation in interruptible rate programs. During the workshop, the representative of one major aerospace company was paged by the president of his company to set up meeting to discuss interruptions after power at the company's facility was interrupted for the third day in a row.

III.C.i.b. Labor

Immediate access to intellectual capital is one of the main reasons the aerospace industry is still operating in California.

- California universities offer world-class science and research capabilities in engineering, physics and mathematics. These universities are a continuing source of well-qualified engineers and scientists and provide a continually expanding base of knowledge and expertise.

- California has a large pool of skilled and experienced workers, but California's aerospace firms face increasingly stiff competition from internet-based companies and other high tech operations.

- In addition to offering solid career opportunities for good pay and good benefits for well-qualified technicians, California's aerospace companies are repositioning themselves to compete for top engineers and scientists.

The regulatory environment also affects the future of California's aerospace industry, as discussed next.

III.D. Regulatory

i. Mitigate Regulatory Burdens, Constraints

Burdensome government regulations increase aerospace industry costs. According to participants, streamlining would substantially reduce the aerospace industry's regulatory costs.

A stable and flexible regulatory environment would help reduce both the costs of investment capital and development.

- Government-sponsored products are subject to standards and require exhaustive documentation (in case of a tragedy, every part will be tracked back to its origins, and new standards will be enacted to avoid a future tragedy). These sorts of practices drive costs up dramatically.

- Furthermore, rapid technology developments can make regulations obsolete as soon as they are issued, implying that old regulations that are no longer relevant should be eliminated. Instead, companies are required to satisfy all of the old requirements plus any additional ones that are added.

Current utility-sponsored Standard Performance Contracting programs require extensive paperwork and M&V.

III.D.ii. Export Controls

Tight export controls jeopardize global competitiveness in the important commercial space export market.

- Large commercial satellites were reclassified as weapons (no information can be handed to overseas clients) after a 1998 government investigation into allegations of the industry's selling secrets to China.
  - At least partially due to this reclassification, the aerospace industry's share of the world market decreased from 68 percent in 1998 to 32 percent in 1999, according to the Aerospace Industries Association.
  - France, a major competitor, increased its market share from 32 percent to 68 percent during the same period. Similar export restrictions on satellites do not exist in France, according to the Aerospace Industries Association.
  - In addition, the transfer of regulatory control to the State Department has created a licensing backlog in satellites, launch vehicles, and their components.
- Even Defense Department officials concede that the entire Cold-War-era licensing regime is obsolete.[1]

Opportunities for utility programs to meet the needs of its aerospace industry customers are discussed in the next section.

[1] Sietzen, Frank. "Red Tape Grounds Satellites," Space.com, 2000.

IV. Program Strategies

A. Overview

There are a series of promising opportunities for California's utilities to assist its large aerospace industry customers in meeting some of their most important needs. These opportunities include:

- Enhance productivity and efficiency by assisting the aerospace industry in developing efficient manufacturing strategies.
- Forming strategic industry partnerships that leverage California's technology strengths and encourage commercialization.
- Offering competitive transition assistance by advising the aerospace industry regarding California's changing utility market to help ensure a reliable energy supply.
- Increasing energy reliability to meet the California aerospace industry's need for a reliable energy infrastructure.

Each recommendation is discussed in more detail below.

Exhibit C-5
Aerospace Industry Needs and Wants Program Selection Matrix

Recommendations	Selection Criteria: Industry Related Needs and Wants — Market: Be a Low-Cost Provider	Market: Expand Manufacturing Operations	Market: Manage Financial Risks	Market: Re-establish Market Niche	Technical: Obtain Reliable Infrastructure Supply	Technical: Avoid Process Interruption	Technical: Enhance Productivity	Technical: Enhance Flexibility of Production Facilities	Regulatory: Mitigate Regulatory Burdens, Constraints	Regulatory: Seismic Retrofitting Assistance
INCREASE ENERGY EFFICIENCY OF FACILITIES										
Support ESCO Activities Attuned to Industry Needs	●			○	●					
Streamline SPC Process	●								◒	
Educate Facility Managers re Business Case Presentations	◒									
Support Building Commissioning										
Support Open Architecture for Metering, Submetering										
ENHANCE PRODUCTIVITY AND EFFICIENCY										
R&D Collaboration	●									
Industry-specific Demonstrations and Case Studies	●			◒						
Design Assistance										
BUILD COOPERATIVE RELATIONSHIPS										
Partnerships between Industries and Utilities	◒			●	●				●	
COMPETITIVE TRANSITION ASSISTANCE										
Advice to Industry about California Energy Market	●		◒		●				●	
Financial Instruments to Manage Energy Price Risks	●		◒		●				●	
INCREASE ENERGY RELIABILITY										
Load Management					●					
Funding for Distributed Generation and Cogeneration	◒				●					

KEY
Relevance
● High
◒ Medium
○ Low

IV.B. Enhance Productivity and Efficiency

Utilities should also consider programs that assist the aerospace industry, and other industries, develop efficient manufacturing strategies to maintain and win back state industry.

- Workshop participants suggested taking one percent of aerospace-industry-generated utility revenues and:
  - Provide funding to organizations investigating possible process improvements in the aerospace industry that could result in substantial reductions in production costs.
- Both the aerospace industry and the California IOUs would benefit from programs that increase efficiency and productivity as well as reduce total operating costs, thereby making California's aerospace industry more competitive nationwide.
- The California IOUs could consider supporting research efforts by industry experts, as opposed to developing industry-specific process expertise in-house. Partnerships with existing research organizations, such as EPRI and/or university-sponsored centers for energy and environmental resources, should be considered.

IV.C. Build Cooperative Relationships

Strategic partnerships are mutually beneficial — they have the potential to increase the utility industry's presence at the state level and ultimately (though indirectly) assist the aerospace industry win and retain more contracts.

Workshop participants perceive the needs of the aerospace industry and the IOUs as being similar; as such, forming strategic partnerships, with strong leadership, would be beneficial to both industries, and to the state as a whole.

- Sacramento does not, according to workshop participants, treat aerospace as the state's largest employer; agriculture and entertainment, for example, get much more attention relative to their impacts on the state.

- A partnership between utilities, the local (as opposed to corporate) aerospace industry, and other industries with similar needs will help to:

  – Create a unified front to effectively present joint utility and aerospace industry needs to California's political decisionmakers. It is very important to secure a powerful champion and leader for this effort, someone that can spearhead joint industry efforts. Currently, there are a series of relatively smaller activities underway, but no joint, integrated force providing overall leadership and direction.

  – Lobby the state government to pass legislation that is effective in keeping industry in California, and that is effective in recognizing and meeting the mutual needs of the state and its utilities.

  – Ensure that a large business advocate is represented as a commissioner in the CPUC.

  – Make the need for a joint economic development entity among California aerospace firms, economic development organizations, and IOUs become a reality.

IV.C. Build Cooperative Relationships (continued)

- Utilities can leverage existing coalitions for joint political action.
  - The California Manufacturers and Technology Association (CMTA), an association of large energy users, is an important leveraging element.
  - The Silicon Valley Manufacturing Group is a coalition of high-tech firms and supporting industries (i.e., segments of the aerospace industry) that works with government to solve policy concerns that affect business. SVMG's energy task force currently analyzes members' energy reliability needs and develops energy efficiency and load management plans.
  - The California Space and Technology Alliance is a nonprofit advocacy group that advises Sacramento on how to best support California-based space assets. In 1999, the US Congress appropriated $8.5 million to the California Space Infrastructure Program (CSIP), a study to define viable the State's space infrastructure needs from business and technical perspectives.

IV.D. Competitive Transition Assistance

i. Advise Industry Regarding California's Energy Market

Providing the aerospace industry with clear, concise and accurate information about the future of California's electricity market is an important activity that the utilities can undertake. Aerospace industry customers would welcome utility input on future electricity reliability and cost.

- Companies in the aerospace industry (and in California's other industries) need good information on the current and future outlook of the utility industry. High-level interactions between utility and aerospace industry leaders are recommended. Workshop participant comments on the current status of electricity supply in California include:
  - Electricity reliability, a key need of the aerospace industry, is capacity-driven; utilities and regulators must address the perceived problem with the grid.
  - There is no economic model that justifies generation plant (or transmission upgrade) investments in California.
  - In March 2002, the rate cap for the other large IOUs will be lifted. Workshop participants are very concerned that skyrocketing electricity prices, especially in the San Diego area, will add millions of dollars to their aerospace costs as well as the supply chain. These problems must be addressed now, as the timing is becoming urgent.
- Presenting the results of a risk assessment of likely electricity supply and cost outcomes to aerospace industry leaders would be most useful.
  - This would begin by identifying and assessing the key factors — generation capacity, T&D capacity, legislative mandates, etc. — that affect future electricity supply and price.
  - A customizable software tool should be developed and used to generate risk profiles for electricity supply and price, using key risk variables and industry expert assessments.
- The results of these assessments can then be presented to aerospace industry executives in a simple, easily understood format that provides the aerospace industry with valuable input on future electricity reliability and supply issues.

IV.E. Increase Energy Reliability

As discussed in the previous section, a reliable support infrastructure ¾ including a reliable energy supply ¾ is critical to aerospace industry viability. The industry would benefit greatly from programs that provide direct benefits to the industry and contribute to enhancing the reliability of California's electricity supply (from both an availability and cost perspective).

- Load management programs that provide financial benefits to aerospace industry customers and, at the same time, assist in addressing California's peak demand issues would be beneficial to both the aerospace industry and the California IOUs. Re-examination, and possible expansion of existing programs, as well as the adoption of new programs, is strongly recommended.

- Streamlined energy efficiency programs (such as a streamlined Large SPC program) would be beneficial to both the aerospace industry and the utilities. Streamlining has the potential to substantially increase participation and cost-effectiveness.

- Innovative distributed generation and cogeneration programs (such as the pooled demand programs offered by utilities in the Midwest) could be considered by some utilities since these programs, if properly designed and implemented, could assist in meeting the reliability and cost containment needs of both the utilities and its aerospace industry customers.

IV.F. Summary

Like the utility industry, California's aerospace industry is in a period of economic flux with both substantial opportunities and threats. Opportunities exist for the utility and aerospace industries to work together to meet common objectives.

- While defense procurement is somewhat stagnant, California can leverage its technology strengths to lead aerospace commercialization in high-demand areas, such as satellite manufacturing and launch services. Thus, California is well positioned to anchor future aerospace industry prosperity.

- California utilities can play a critical role in ensuring energy reliability, advising the aerospace industry on the volatile energy market, making California a more favorable environment for industry, and helping the aerospace industry to develop more efficient production processes.

D. PRESERVED FRUIT AND VEGETABLE INDUSTRY ASSESSMENT

I. Introduction

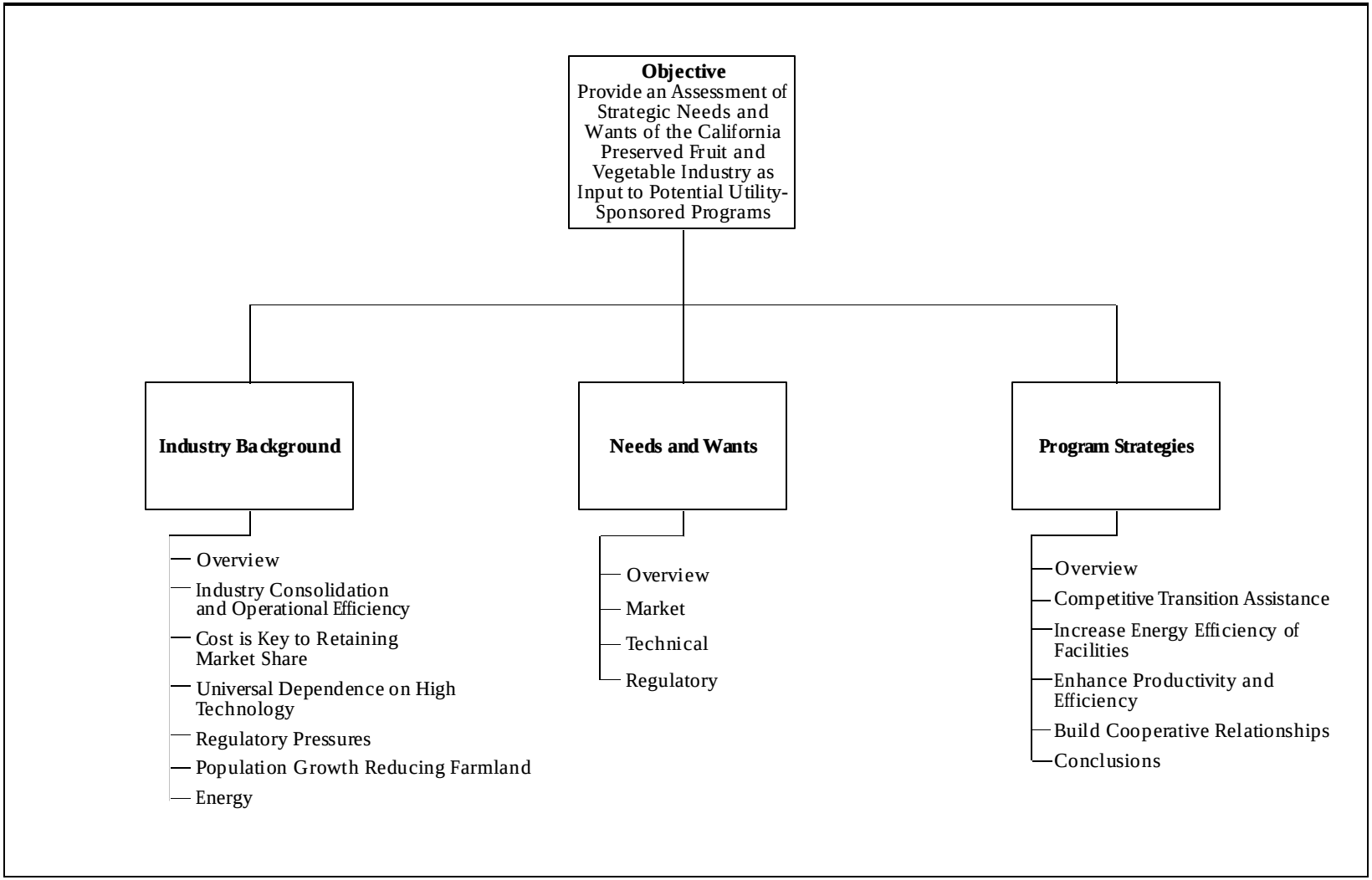
This chapter provides an assessment of the strategic needs and wants of California's preserved fruit and vegetable industry as input into potential utility-sponsored energy-efficiency programs for California's large customers.

An overview of the chapter's contents is presented in Exhibit D-1 and summarized below.

- The chapter begins with an overview of California's preserved fruit and vegetable industry to set the stage for discussion of the industry's needs and wants.
- The fruit and vegetable processing industry's needs and wants are then discussed.
- Opportunities for utilities to design energy-efficiency programs to meet industry needs are presented in the final section. These recommendations are intended to be beneficial to both California's utilities and fruit and vegetable processing industry customers.

This assessment is based on an analysis of the results of a workshop held with five industry experts in October 2000 and a review of secondary sources. Lists of workshop participants and secondary sources are included in the appendix.

Exhibit D-1
Assessment of Preserved Fruit and Vegetable Industry Needs and Wants
As Input to Potential Utility-Sponsored Programs



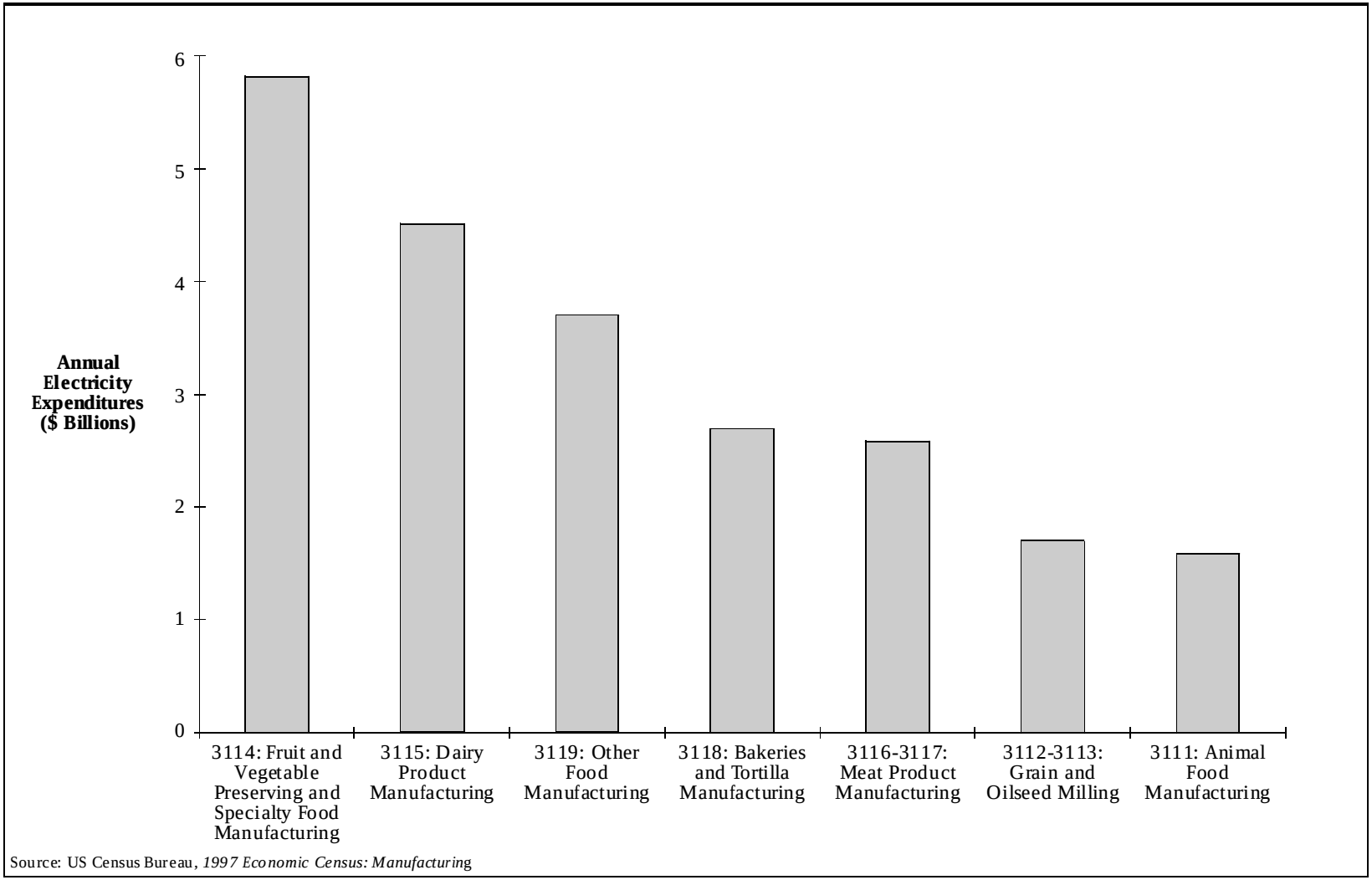
II. Industry Background

A. Overview

California is the largest agricultural state in the nation. As a result, California is also the largest food-processing employer in the US, according to the California Trade and Commerce Agency. This assessment focuses on the preserved fruits and vegetables group, the biggest energy user among California food processors, as illustrated in Exhibit D-2.

- The preserved fruits and vegetables industry has five groups. California is the largest US producer of three of these five groups, as illustrated in Exhibit D-3.
  - California has a 29 percent share of the $16 billion *fruit and vegetable canning* market, which was the largest industry group in 1997, according to the US Economic Census. This group consists of establishments primarily engaged in manufacturing canned, pickled and brined fruits and vegetables. Examples of products made in these establishments are canned jams and jellies, canned tomato-based sauces such as catsup, salsa, chili, spaghetti, barbecue sauce and tomato paste; pickles, relishes and sauerkraut.
  - *Frozen specialty food manufacturing* — where total value of shipments was approximately $10 billion in 1997 — is the second largest industry group. California has 9 percent of this market, second to Ohio. Frozen specialty foods (except seafood) are frozen dinners, entrees, and side dishes; frozen pizza; frozen whipped topping; and frozen waffles, pancakes and French toast.
  - *Frozen fruit, juice and vegetable manufacturing* is primarily engaged in manufacturing frozen fruits, frozen vegetables and frozen fruit juices (-ades, drinks, cocktail mixes and concentrates). Florida produced 20 percent of US shipments in 1998 (valued at $9.6 billion), followed by California's 11 percent market share.
  - California accounted for 14 percent of the $8 billion *specialty canning* market in 1997, which includes canned baby food, baked beans, soups, spaghetti sauce.
  - California produced 57 percent of the nation's *dried and dehydrated food shipments* in 1997. These manufacturers are primarily engaged in drying fruits, vegetables, and soup mixes and bouillon as well as drying and/or dehydrating ingredients and packaging them with other purchased ingredients, such as rice and dry pasta.

Exhibit D-2
1997 Annual Electricity Expenditure by Industry Group



Source: US Census Bureau, *1997 Economic Census: Manufacturing*

- California food processing employed 183,300 people in 1999. The preserved fruits and vegetables group accounted for one quarter of California's processing jobs.[1]
  - Seasonal harvesting results in an annual employment surge in the late summer.
  - The food processing industry provides thousands more jobs in directly related industries such as food wholesaling and retailing. More jobs are linked through manufacturers of packaging materials, industrial and agricultural chemicals, biotechnology products, and farm and food production machinery.
- The processing of fruits and vegetables is especially significant in the San Joaquin Valley, Sacramento Valley and Central Coast. The San Joaquin Valley and in particular Fresno County leads the rest of the state and the nation in food production. Fresno County shipped $770 million of preserved fruits and vegetables in 1999.[2]
- Tomato processing is a particularly significant product area due to the explosion of fast foods that use tomato products.
  - California food processors grow, product, pack and ship 45 percent of the world's processed tomato products, according to the California League of Food Processors and over 95 percent of the tomatoes in the US consumed as prepared sauces, salsas, soups, ketchup and more.[3]
    - .. California processors can, freeze or dry 11 million tons of tomatoes during a typical yearly harvest season. Harvesting, hauling and processing go on nonstop around the clock from July to October, as trucks load up at the fields and head for the processing plants — Campbell Soup, Hunt-Wesson, Del Monte, H.J. Heinz, Morning Star Packing, Colusa County Canning and Pacific Coast Producers.

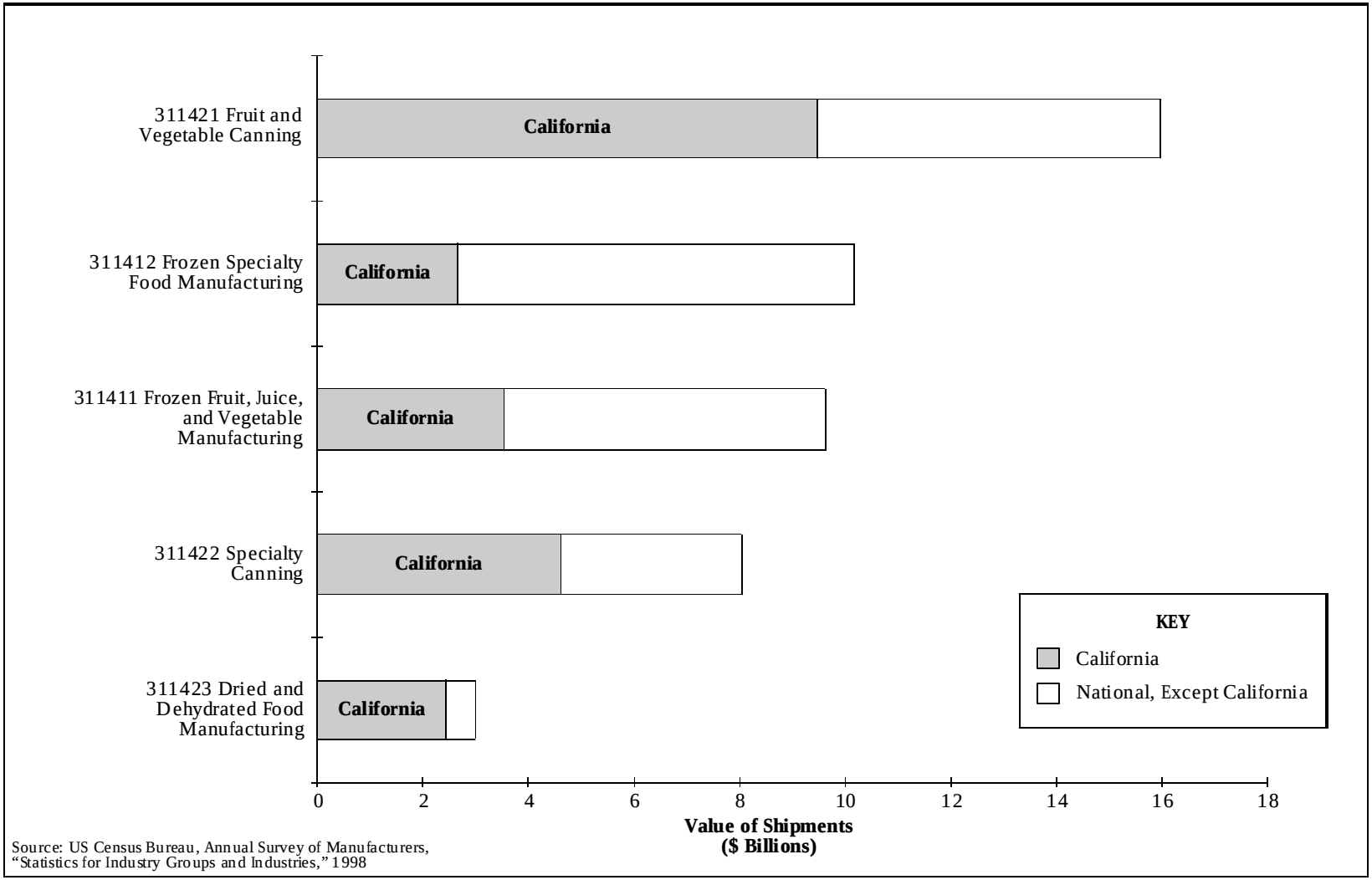
[1] California Trade and Commerce Agency, Office of Economic Research. "The California Food Processing Industry," Sacramento, CA, 2000.

[2] Ibid.

[3] Processed Tomato Foundation; www.tomatonet.org/processed.htm.

.. The acreage for processed tomatoes — about 300,000 acres — is ten times larger than acreage for the fresh tomato market (Schnitt, 1999; California Tomato Growers Association).

Exhibit D-3
Total Value of Shipments by
Preserved Fruit and Vegetable Industry Group and Leading US States



Source: US Census Bureau, Annual Survey of Manufacturers, "Statistics for Industry Groups and Industries," 1998

- California is the only producing state of such specialty foods as almonds, artichokes, raisins, prunes, olives, dates, figs and pistachios. These specialty fruits and vegetables are lightly processed by California's large cooperative processors like Sun Maid Raisins and Blue Diamond Growers.[4]

- California is the leading agricultural export state, although the market for US processed foods is largely domestic.

  – Food products were California's fifth largest export after electronics and transportation, and represented 5 percent of total California manufactured exports in 1999.[5]

  – Its location gives California an advantage in exporting to Canada, Mexico and the Pacific Rim. California exported $4.4 billion worth of food and kindred products in 1999 — Japan accounted for one quarter of those exports — but export volume declined 17 percent from 1998.[6]

[4] California Trade and Commerce Agency, 2000

[5] Ibid.

[6] Ibid.

II.B. Industry Consolidation and Operational Efficiency

Concentration in the food processing industry is the result of a consolidation trend down the food chain, starting in supermarket retailing — the "Wal-Mart syndrome" — and changes in consumer tastes, according to participants.

- Increases in retailers' market power have forced consolidation down the food chain — packers, processors, and the family farm — as each level looks for cost efficiencies through scale.[7]
- Consumers are becoming increasingly time- and health-conscious, which affects the foods they demand, and, in turn, how food is processed.
  - Lifestyle changes — increased demand from two-worker and single parent families with less time for shopping and meal preparation — are driving the emerging convenience market.[8]
  - There is increased consumer interest in the health benefits of all food products. Consumers demand minimally processed foods with maximum nutrient retention.
- As a result, per capita consumption of fruit and vegetable products is fairly static, except for the explosion of fast foods that use tomato products.[9]

To counteract slow growth and pricing pressures, fruit and vegetable processors have consolidated in order to gain operational efficiencies through economies of scale.

---

[7] Wirtz Ronald A., "Concentrating on Food Concentration," *Fedgazette*, vol 12, number 1, http://minneapolisfed.org/pubs/fedgaz/00-01/food.html, January 2000.

[8] California Trade and Commerce Agency, 2000

[9] Bacheldor, Beth, "IT: Always in Good Taste," *Information Week,* www.informationweek.com/803/food.htm, September 11, 2000.

II.C. Cost is Key to Retaining Market Share

Fruit and vegetable processors must drive their costs down in order to maintain market share, according to workshop participants.

- The low-cost producer wins market share because price matters most in the fruit and vegetable products market, according to workshop participants.
  - The key problem for California processors is that inputs — wages, energy and other costs of doing business — are higher in California than in other states. These can be offset somewhat by the development of higher value, specialty products, ready access to markets and access to suppliers and raw materials.[10]
- Workshop participants are also concerned about international competition.
  - China surpassed the US in 1995 as the number one producer of total tomatoes and its tomato production continues to grow rapidly. China built five factories last year and is slotted to build another six. According to participants, China has an area of land larger than the San Joaquin Valley that can accommodate further growth. According to workshop participants, China's tomato production is more than competitive with California's, including shipping costs.
  - China leads the world production of asparagus, mushrooms, garlic, diced onions, potatoes, carrots, lettuce and several other commodities, according to the California League of Food Processors.

[10] Economic Development Alliance for Business, "1997-2002 Strategic Plan," www.edab.org/hold/strategic1.html, 1996.

II.D. Increased Dependence on High Technology

The California preserved fruit and vegetable industry increasingly depends on technological innovations to reduce labor costs and increase operational efficiency.

- The food processing industry is a large user of programmable logic controllers, devices that control and sequence machinery in washing, sorting, mixing and packaging.

- Emerging technologies include:

  – *Food irradiation*: foods are exposed to high-frequency waves. Energy from the waves is transferred to the food, changing the composition of the food cells changes and thereby destroying microorganisms. Flavor and nutrients are retained better than in any other processing method because irradiation uses only a minimal amount of heat.[11]

  – *High-pressure processing* (HPP) involves subjecting packaged food and water in a chamber to hydrostatic pressures between 50,000 and 100,000 pounds per square inch (psi) in order to kill the microbes that spoil food." Essentially, HPP is canned food without the heat. Foods are preserved without undergoing the changes in flavor, color, texture, aroma or nutritional value that are often linked to heat processing.

  – *Robotics*: robots have replaced human hands in materials handling and other processing tasks, such as moving product from a conveyor belt to a box or another conveyor belt.

- The equipment supplier community acts as food processors' R&D arm, according to workshop participants.

- California universities and colleges conduct R&D on agricultural products and food processing. The University of California at Davis runs one of the most renowned research facilities. Food processors incorporate new research in their business practices.

---

[11] Thornberg, Linda, "Food Processing," *Compton's Encyclopedia,* www.comptons.com/encyclopedia/ARTICLES/0050/00676096_A.html, 2000.

II.E. Regulatory Pressures

Regulatory oversight will continue to drive industry standards and business practices. Food quality standards in the US are recognized as some of the toughest in the world.

- At the federal level, the Department of Agriculture and the Food and Drug Administration provide the regulatory oversight to help ensure safe production and distribution of foods.

- State government creates real impediments to doing business in California, according to workshop participants. As a result, processors are relocating to states with more favorable regulatory environments, such as Texas.

  – Workshop participants observed that California regulatory agencies sometimes do not coordinate functions. Examples cited by workshop participants include a water board fighting an air board with no coordination on the larger environmental picture.

  – While there are local economic development efforts in places like Modesto, workshop participants said there is little to no connection of the food processing industry to the regional or state level.

  – Environmental organizations use lawsuits to intimidate regulators, according to workshop participants.

According to workshop participants, fruit and vegetable processors — like other manufacturers — are leaving California due to over-regulation.

II.F. Population Growth Reducing Farmland

California's growing population threatens existing farmland, according to workshop participants. Once lost, the land will never be returned.

- California's population grew by 44 percent from 1980 to 2000, causing housing to encroach on agricultural land and forcing food processing plants to relocate, according to participants. The growing population competes with the needs of agriculture.

- Workshop participants observed that regulation increases as communities grow toward processing plants. For example, urban encroachment affects zoning for food processing operations.

II.G. Energy

Fruit and vegetable processing is less energy-intensive than some other manufacturing sectors, but energy is a significant cost in this low margin industry.

- As illustrated in Exhibit D-4, most food processors spend five percent or less of their production costs on energy — which is used in food preparation, cooking and heat treatment and refrigeration applications — but in a low margin industry, five percent is significant.[12],[13]
  - Some processors, particularly frozen food processors, went on interruptible rates to cut costs, according to participants.
  - Workshop participants expect increased energy costs to have a major negative impact on their business.
  - Electricity cost plays a role in processors' global competitiveness. Workshop participants observed that it is difficult to compete with countries where electricity is 6 cents versus their 10-12 cent rate.
- Technology investments make power quality increasingly important, according to workshop participants.
  - Power system reliability is poor, impacting operations and planned maintenance systems, according to California food processors interviewed by the California Institute of Food and Agricultural Research.[14]
  - Workshop participants suggested that utilities invest in more capacitor banks and power-related technology to improve power quality.
- Investments in energy efficiency are not as cost-effective for seasonal food processors as other business sectors. While some processors, such as frozen foods companies, operate most of the year, others are highly seasonal — for instance, the prune processing harvesting period lasts only four to six weeks.

The preserved fruit and vegetable industry's needs and wants are discussed in the next section.

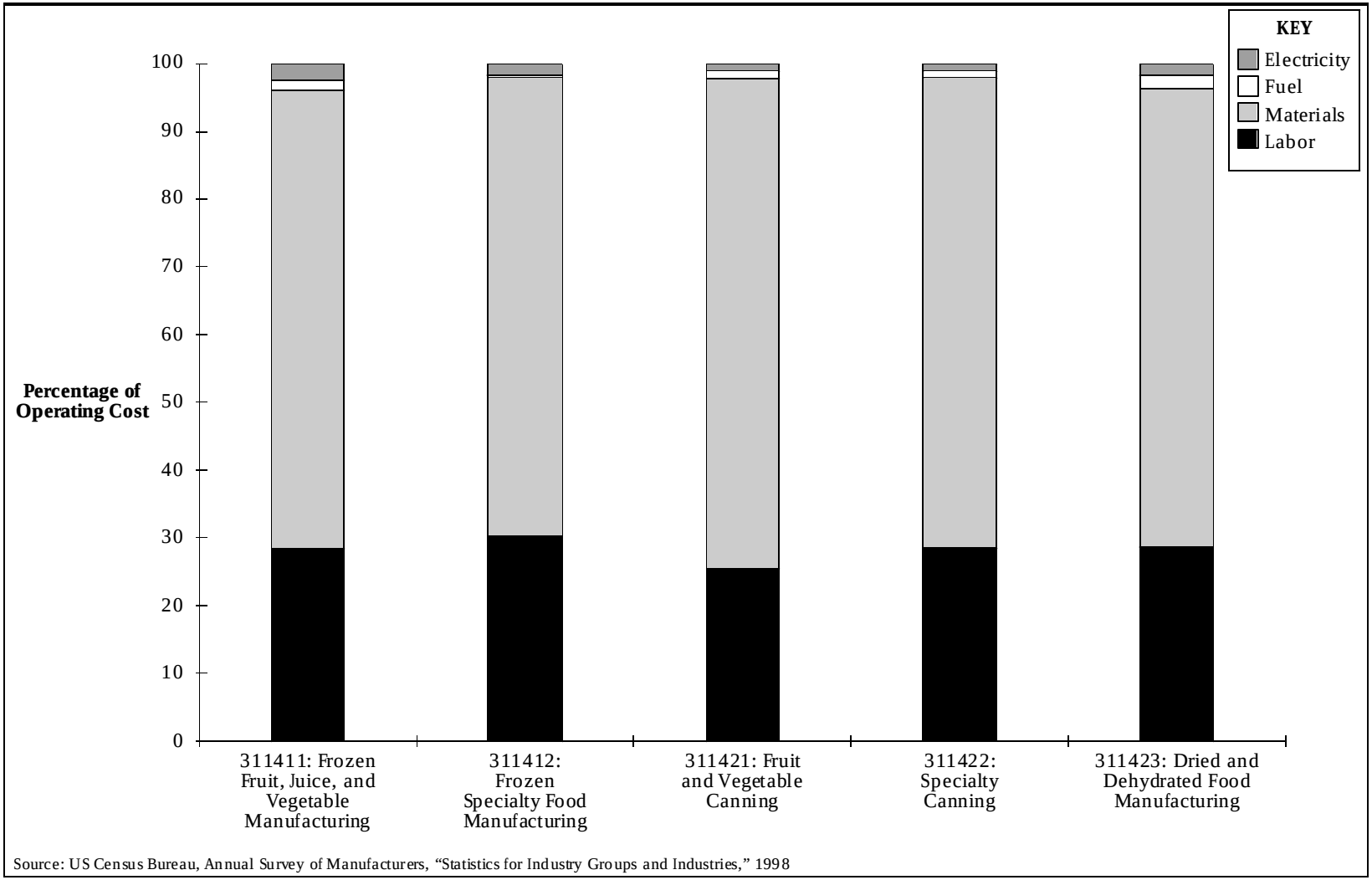
---

[12] California Institute of Food and Agricultural Research, "Survey of Energy Management in the California Food Processing Industry," UC Davis: College of Agricultural and Environmental Sciences, 1999.

[13] As an upper bound, the electricity intensity of industrial gas manufacturing was 26 percent of operating costs (NAICS 325210) in 1997.

[14] CIFAR, 1999.

Exhibit D-4
Operational Cost Distribution in Preserved Fruit and Vegetable Industry Group
(1997)



Source: US Census Bureau, Annual Survey of Manufacturers, "Statistics for Industry Groups and Industries," 1998

III. Needs and Wants

A. Overview

Cost management and regulatory relief top California's preserved fruit and vegetable industry's needs and wants.

- California fruit and vegetable processors seek cost competitiveness through operational efficiencies. Therefore, the cost and quality of critical inputs — water, labor, and energy — are serious concerns to the industry.

- While workshop participants acknowledge that regulation is needed to ensure safe, good-quality products, they seek relief from the undue burdens of the California regulatory regime.

Exhibit D-5
Summary of Industry-specific Needs and Wants
Preserved Fruit and Vegetable Industry

Industry Segments	Industry-specific Needs and Wants									
	Market				Technical				Regulatory	
	Be a Low-Cost Provider	Expand Manufacturing Operations	Manage Financial Risks	Re-establish Market Niche	Obtain Reliable Infrastructure Supply	Avoid Process Interruption	Enhance Productivity	Enhance Flexibility of Production Facilities	Helps Mitigate Regulatory Burdens, Constraints	Seismic Retrofitting Assistance
Semiconductor										
R&D facilities		◒				●	●	◒	◒	
Fabs		◒				●	●	◒	◒	
Foundries	◒	◒				●	●	◒	◒	
Equipment suppliers (toolmakers)		◒				◒	◒			
Biotechnology										
R&D facilities			●		●	◒		◒	◒	
Production facilities	❍	●	●		●	●		◒	◒	
Aerospace										
R&D and New Technology Development	◒		◒	●	●				●	
Assembly	●		◒	●	●				●	
Fruit and Vegetable Processing	●		●		●		◒		●	
Hospitals	●		◒		◒	◒			●	●

KEY
Importance
● High
◒ Moderate
❍ Low

III.B. Market

i. Be a Low Cost Provider

As a commodity priced business, cost competitiveness drives fruit and vegetable processors.

- As "price takers" dependent upon fluid commodity markets and retailers' pricing pressures, fruit and vegetable processing is a very competitive industry with thin profit margins. Since processors have little control over market prices, their financial health relies on their ability to effectively control costs.
- Workshop participants expressed concern with the cost and availability of three critical inputs — water, labor and energy.
  - *Water* is an essential component of food production, processing and preparation. Processors need quality water at reasonable cost. Mismanaging either water quantity or quality can kill a processing business.
    - .. Demand for water in California already exceeds water supply during drought years.
    - .. At the current rate of population growth, water experts expect that California will have a three to seven million-acre-foot-per-year shortage by the year 2020 (US Congress, 1998).
  - The industry has reduced its labor force through automation, but now faces a shortage of instrumentation and IT people to staff its high tech processing operations. Some processors partner with local schools and community colleges to train skilled technicians, but recruiting and retention remains a challenge because people can get better jobs in the high-tech sector. In addition, a booming economy has cut into the availability of seasonal line workers. Despite labor-saving devices, workshop participants report that processors do not have enough people to "run the product."
  - Fruit and vegetable processors expect that increases in *electricity* costs will affect the viability of their business. As one participant noted, "The industry does not have margins to support significant increases in energy cost — nobody's going to pay $1.50 for a spoonful of soup." Workshop participants also expressed concern about uncertainty and turmoil in the deregulated energy market. They want a better understanding of how market mechanics work and strategies for shifting risk.

Increased input costs affect processors' bottom line, given the highly competitive cost structure of the industry.

III.C. Technical

i. Obtain Reliable Infrastructure Supply

a. Water

California processors are concerned about the availability and quality of natural resources — especially water — needed for industry growth.

- The food processing industry remains a large water user despite profound efficiency improvements — only two cups of water are needed to process a pound of tomatoes, according to workshop participants.
  - Water is used as an ingredient, an initial and intermediate cleaning source, an efficient transportation conveyor of raw materials and the principal agent used in sanitizing plant machinery.[15] Its use starts with conditioning raw materials, such as soaking, cleaning, blanching, and chilling. It continues with cooling, sanitizing, steam generation for sterilization, power and process heating, and, finally, direct 'in-process' use.[16]
  - For example, one California frozen foods company uses a million gallons of water a day to steam and blanche vegetables, to irrigate, to create steam. This water is continually recycled — used at least twice, and up to four or five times — in its operations.
- Workshop participants are concerned about California's water future, noting that the state has made no infrastructure investment in water in the past 15 years.
- Disposal of wastewater is the industry's biggest operating issue, according to participants. Large quantities of wastewater are generated mainly from cooking processes, cooling waters from heat exchangers and in process vat cleaning processes.[17]

---

[15] Civil Engineering Research Foundation, "Clean Technologies in U.S. Industries: Focus on Food Processing," www.usaep.org/reports/food.htm.

[16] Flores, Rolando A., G. M. Powell, and F. M. Aramouni, "Water Supply for Food and Beverage Processing Operations." Publication MF-1122, Cooperative Extension Service, Kansas State University, Manhattan, Kansas, www.oznet.ksu.edu/dp_grsi/Flores/Resume/Extension%20Publications.htm, 1994.

[17] Civil Engineering Research Foundation, "Clean Technologies"

III.D. Regulatory

i. Less Burdensome Regulations at the State Level

Workshop participants want regulatory coordination and streamlining at the state level.

- Workshop participants view government as among the most important factors in their business and the most difficult to deal with. Participants felt that the governmental infrastructure needs a redesign, but acknowledged the difficulty of streamlining such a complex regulatory environment.
- Workshop participants seek economic development efforts at regional and state levels.
- Better coordination among government agencies, which often work at cross-purposes, is needed to improve responsiveness.
- State government needs a better understanding of wastewater, according to workshop participants. Participants noted that the California Manufacturing Technology Association and the California Chamber of Commerce are partnering on this issue and hope to see industry coalitions address wastewater on a major scale.

Opportunities for utilities to meet the needs of their preserved fruit and vegetable industry customers are discussed in the next section.

IV. Program Strategies

A. Overview

There are some opportunities for California's utilities to assist fruit and vegetable processors regarding some of their most important needs. These opportunities include:

- Helping processors deal with volatility in the deregulated energy market by:
  - Providing market intelligence on California's energy outlook.
  - Helping fruit and vegetable processing customers build a portfolio of financial instruments, such as hedging, for managing risk exposure.
- Helping processors manage their energy costs by:
  - Advising them on how to obtain better rates by matching loads with other seasonal energy users (i.e. schools) or processing at night.
  - Developing open architecture for metering, which enables customers to better manage their energy usage.
  - Seeking industry input in customizing energy efficient programs to the needs of processors.
  - Coordinating how IOUs and munis serve agribusiness.
- Targeting upstream market participants, such as equipment suppliers, to fund energy-saving process improvements.
- Utilities acting in concert with the food processing industry on the water issue. As water users, utilities and manufacturers both want to ensure California's supply of high-quality water.

Each of these is discussed in detail on the following pages.

Exhibit D-6
Preserved Fruit and Vegetable Industry Needs and Wants Program Selection Matrix

Recommendations	Selection Criteria: Industry Related Needs and Wants — Market: Be a Low-Cost Provider	Market: Expand Manufacturing Operations	Market: Manage Financial Risks	Market: Re-establish Market Niche	Technical: Obtain Reliable Infrastructure Supply	Technical: Avoid Process Interruption	Technical: Enhance Productivity	Technical: Enhance Flexibility of Production Facilities	Regulatory: Mitigate Regulatory Burdens, Constraints	Regulatory: Seismic Retrofitting Assistance
INCREASE ENERGY EFFICIENCY OF FACILITIES										
Support ESCO Activities Attuned to Industry Needs	●		◒		●					
Streamline SPC Process	◒								◒	
Educate Facility Managers re Business Case Presentations	◒		◒							
Support Building Commissioning										
Support Open Architecture for Metering, Submetering	◒									
ENHANCE PRODUCTIVITY AND EFFICIENCY										
R&D Collaboration	◒						◒			
Industry-specific Demonstrations and Case Studies	◒						◒			
Design Assistance										
BUILD COOPERATIVE RELATIONSHIPS										
Partnerships between Industries and Utilities	◒				●				●	
COMPETITIVE TRANSITION ASSISTANCE										
Advice to Industry about California Energy Market	●		◒		●				●	
Financial Instruments to Manage Energy Price Risks	●		◒		●				●	
INCREASE ENERGY RELIABILITY										
Load Management					●					
Funding for Distributed Generation and Cogeneration	◒				◒					

KEY
Relevance
● High
◒ Medium
○ Low

IV.B. Competitive Transition Assistance

Utilities can assist the fruit and vegetable processing industry in providing market intelligence and building a portfolio of financial instruments to minimize the impacts of price volatility.

- Utilities could provide market intelligence on California's energy outlook. Uncertainty was a recurrent theme of the workshop discussion; processors need to know what is going to happen in this market and utilities are well positioned to offer expert information on the market.

- Although food processors are familiar with commodity markets, workshop participants want a better understanding of how market mechanics work and strategies of shifting risk in the natural gas and electricity markets. Utilities can help educate these customers by co-sponsoring seminars on hedging strategies and other financial instruments with an industry organization.

IV.C. Increase Energy Efficiency of Facilities

Utilities can help the fruit and vegetable processing industry manage energy costs in several ways.

- Utilities could develop an open architecture for metering among utilities, which enables large processing companies using multiple utilities in different regions to easily retrieve and assimilate metering data.
  - Interoperability standards among utilities would help customers to better manage their energy usage across sites by bringing them into their wide area networks or enterprise resource planning systems.
  - Open architecture would also enable the processing industry to benchmark energy costs.
- Utilities could seek industry input in customizing energy efficient programs to the needs of processors. Workshop participants viewed SPC as a cookie cutter approach that doesn't meet the needs of seasonal processors. Industry organizations should be represented during program planning and implementation to help develop energy efficiency programs that offer realistic payback for seasonal processors.
- IOU programs reach only 75 percent of the industry because about one-quarter of fruit and vegetable processing is done in municipal utility districts, according to workshop participants. The IOUs should coordinate with munis that serve agribusiness in order to increase energy efficiency penetration among processors.
- Utilities can advise fruit and vegetable processors on how to obtain better rates.
  - Processors could pool with schools and universities, which do not use much energy in the summer. For example, Fresno County schools and processors could set up one flat load to sell to energy providers.
  - Processors that operate at night may obtain more favorable rates.

IV.D. Enhance Productivity and Efficiency

i. R&D Collaboration

Utilities could fund energy-efficient process improvements by partnering with equipment suppliers, which operate as processors' R&D arm.

- Utilities could fund demonstrations of new EE technology to meet the industry's need for operational efficiency as well as the utilities' need to reduce the electrical load. One recent survey of food processors indicates the industry is interested in robotics, reverse osmosis, freeze concentration, Ohmic heating, pulsed electric field, irradiation and written pole motors.[18]

- For example, Key Technology, an innovative equipment supplier to the food industry, teamed with the US Department of Energy and the National Food Processors Association to demonstrate an energy-saving and waste-reducing blancher/cooker system. Key Technology received a grant from DOE's NICE[3] (National Industrial Competitiveness through Energy, Environment and Economics) Program.[19]

[18] CIFAR, 1999

[19] Office of Industrial Technologies, US Department of Energy, "New Blanching System Increases Productivity while Saving Energy," www.oit.doe.gov/nice3/projects/successes/ener2.shtml.

IV.E. Build Cooperative Relationships

Utilities can work in partnership with the food processing industry and other manufacturers on the water issue.

- Although electric utilities such as PG&E are divesting their hydro assets, utilities remain water users. Utilities and processors have a common interest in ensuring California's supply of high-quality water.

- Utilities could participate in a coalition effort to increase Sacramento's responsiveness to manufacturers' water needs with industry organizations, such as the California Manufacturers Technology Association, the California Chamber of Commerce and the California League of Food Processors.

IV.F. Conclusions

Cost management is imperative for the preserved fruit and vegetable sector. Energy savings is a win-win opportunity for other mature industries, but seasonality makes the economics of energy efficiency problematic for processors.

- While processors have captured savings through some utility programs such as lighting retrofits, utilities will have to develop new options for the fruit and vegetable processing industry. One promising avenue is to partner with food equipment suppliers to fund R&D on energy-efficient processing equipment that meets the industry's need for operational efficiency.

- Workshop discussion surfaced a grave concern with California's energy outlook because processors' slim profit margins cannot support price spikes. Workshop participants know that the viability of their business may turn on energy costs in the summer of 2001. They speculated on the possibility of re-regulation as a temporary measure until supply and demand is realigned. Utilities could provide a valuable service in providing market intelligence to large industrial customers. A study conducted by nationally recognized energy experts could generate this much-needed information on California's energy future.

E. HOSPITAL INDUSTRY ASSESSMENT

I. Introduction

This chapter provides an assessment of the energy-related needs and wants of California's hospital industry as input into potential utility-sponsored energy-efficiency programs for California's large customers. One of the major conclusions of this chapter is that the hospital industry as we know them are in decline, but there are possible roles for utilities in addressing joint health care and utility industry needs. An overview of the chapter's contents is presented in Exhibit E-1 and summarized below.

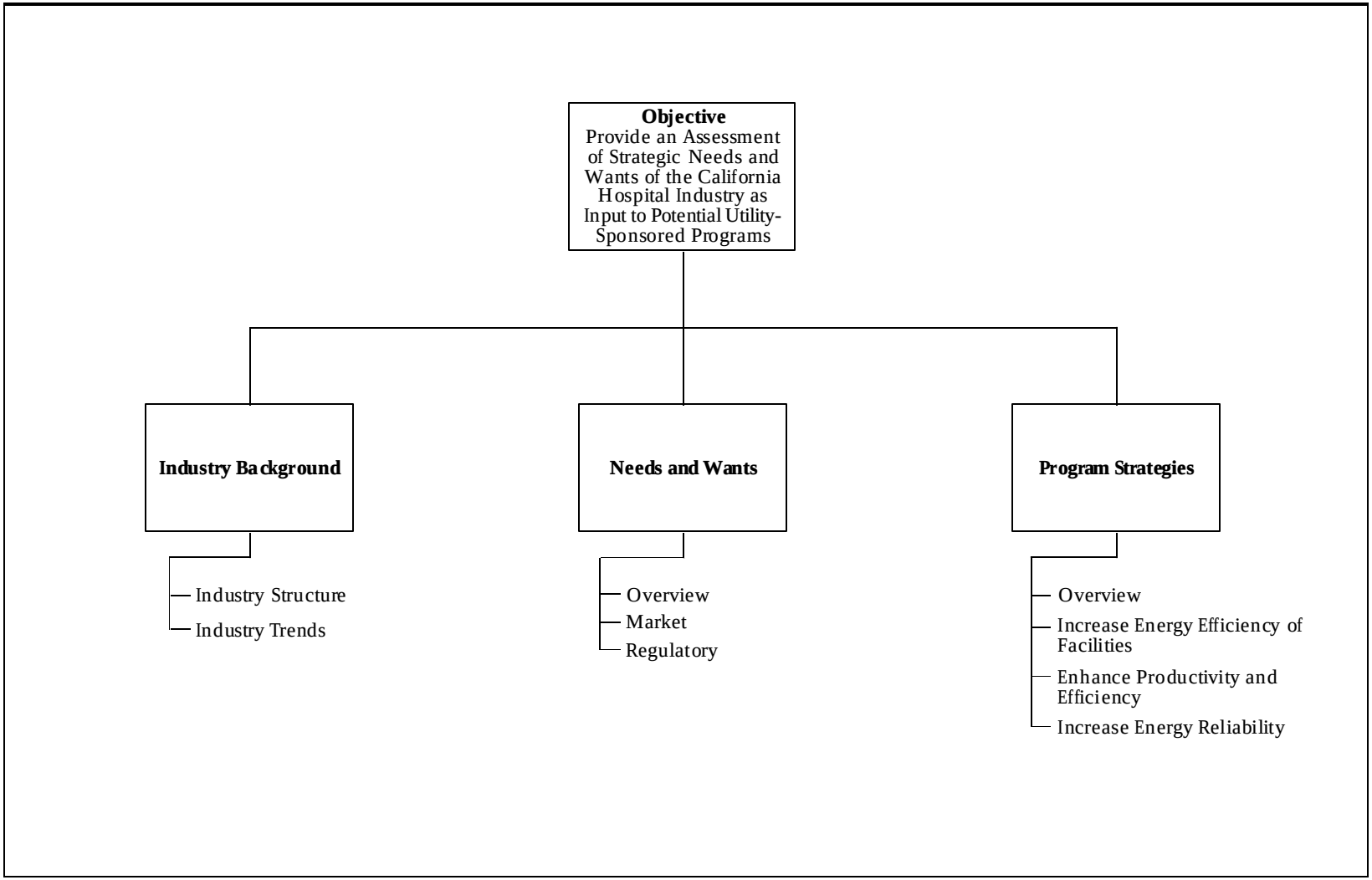
- The chapter begins with an overview of California's health care industry to set the stage for discussion of the hospital industry's needs and wants.

- The hospital industry's need to contain costs and meet regulatory pressures, including California's new seismic standards, are then discussed, with special emphasis on the threats and opportunities facing the health care industry in California.

- Opportunities for utilities to design energy-efficiency programs to meet health care industry needs are presented in the final section. These recommendations are intended to be beneficial to both California's utilities and their health care industry customers.

This assessment is based on an analysis of the results of a workshop held with seven industry experts in July 2000 and a review of secondary sources. Lists of workshop participants and secondary sources are included in the appendix.

Exhibit E-1
Assessment of Hospital Industry Needs and Wants
As Input to Potential Utility-Sponsored Programs



II. Industry Background

A. Industry Structure

The US healthcare facility industry is a broad and diverse industry with several distinct sectors.

- Acute care hospitals comprise the largest sector of the industry. About 6,500 facilities nationwide generate an estimated $400 billion in annual revenues, according to Standard & Poor's.
  - Non-profit entities, which make up approximately 85 percent of the total, dominate the industry.
  - The number of hospitals is declining as consolidation activity continues among the for-profit and tax-exempt chains. The four largest statewide systems will dominate California's metropolitan areas in the coming years — Kaiser Permanente, the Catholic network, non-Catholic nonprofits and a for-profit network, according to the California Healthcare Association Special Report.
  - Other types of facilities are rehabilitation hospitals, psychiatric hospitals, nursing homes, assisted living facilities and home healthcare services.
  - Medicaid recipients accounted for 61 percent of nursing home residents in the US. The skilled nursing home industry is in turmoil as a result of Medicare cuts; industry sources estimate that approximately one in 10 nursing homes is in bankruptcy proceedings.[1]
  - Demographics make assisted living one of the industry's most promising sectors — "Individuals aged 85 and older" is the fastest-growing segment of the US population.[2]
  - The assisted living industry is highly fragmented and dominated by private companies. Several large hotel chains are leveraging their experience to become active builders and operators of assisted living facilities.[3]

This chapter focuses on the acute care hospital sector, the core of the US healthcare delivery system.

---

[1] Standard & Poor's Industry Surveys. *Healthcare Facilities*. Vol 168, no 24, section 3. New York: McGraw-Hill, 2000, p. 12.

[2] Ibid.

[3] Ibid.

II.B. Industry Trends

i. Severe Pricing Pressures

According to workshop participants and secondary sources, California hospitals face severe pricing pressures due to Medicare cuts, low Medi-Cal payments and HMO cost cutting.

- The 1997 federal Balanced Budget Act imposed over $60 billion in Medicare payment cuts upon hospitals for the years 1998 to 2002. This translates into direct Medicare reductions of more than $6 billion to California hospitals, according to the California Healthcare Association Special Report.
  - Nearly half of California's elderly Medicare patients are enrolled in managed care health plans (versus 20 percent for the nation). Medicare payments will become even more important as the population ages. The number of elderly in California will almost double in the next 25 years (California Healthcare Association, Special Report).
  - The government seeks to flatten its reimbursement rate structure and move toward a Medicare reimbursement model that rewards the lowest-cost providers (Standard & Poor's, p. 22).
- Medi-Cal expenditures per eligible patient in FY1997 were $2,543, compared to the New York average of $7,595. Medi-Cal outpatient payments cover less than 40 percent of the cost of outpatient care, according to the California Healthcare Association Special Report.
- Managed care companies seek to lower overall healthcare costs. HMOs typically pay hospitals on a discounted fee basis in return for generating significant volume for hospitals.
- Private insurers have cut back as much as possible on payments to hospitals and doctors. In August 2000, nearly 10 percent of California's hospitals threatened to drop Blue Cross health insurance because it does not pay them enough to cover the cost of patient care.[4]

[4] Los Angeles Times, August 2, 2000, p. A1

II.B.ii. Declining Inpatient Volumes

Declining inpatient volumes, driven in large part by advances in medical technologies, will continue to transform hospitals' traditional roles.

- Inpatient hospital admissions have been steadily falling since the early 1980s due to advances in medical technologies, drug therapies and increased HMO penetration. "It's clear that hospitals — as buildings with beds — are going to shrink, shrink, shrink. It's a declining industry." According to James Robinson, professor of health economics at UC Berkeley.[5]
- There has been dramatic growth in the number of patients treated in outpatient settings (i.e., hospital-based or freestanding outpatient clinics, surgery centers, physicians' offices).
  - More than 60 percent of all hospital operations are now done on an outpatient basis, up from 48 percent a decade ago[6]
  - Industry-wide, outpatient visits reached 440 million in 1997, up sharply from 210 million in 1973, according to the most recent data available from the American Hospital Association.[7]
- New medical technologies promise to further transform the way medicine is delivered.
  - "Telemedicine" (two-way audio-visual communication systems) will allow physicians to pay electronic house calls to remote patients.
  - Robotic surgery will make surgical procedures, even heart surgery, less invasive through development of new robots that can manipulate surgical tools in response to voice commands. The combination of telemedicine and robotic surgery enables doctors to perform long-distance surgery via a robotic arm controlled by a computer.
  - Smart information systems and paperless patient records promise to facilitate communication between remote facilities and ease transmission of medical information.

---

[5] Roni Rabin, "Operating in a New Realm," *Newsday*. Available http://www.future.newsday.com/2/ftop0221.htm

[6] Ibid.

[7] Standard & Poor's, pp. 8-9

II.B.iii. Thin Profit Margins

Overall, hospital profits will be thin, with two-thirds of California hospitals experiencing break-even operations or losses due to declining volumes and market pressure on prices, according to C*alifornia Health Care 1999-2005*.

- Hospital income depends upon the number of patients multiplied by the length of stay. Alternatives to hospital care, such as outpatient procedures and drug therapies, are squeezing the income side.

- 64 percent of California hospitals have negative operating margins, according to California's Office of Statewide Health Planning and Development (OSHPD) data.

- Beginning in the early 1990s, patient care revenue no longer covered the cost of providing care. Patient margin (patient revenue less expenses) was a -5.31 percent in 1999, according to OSHPD.

II.B.iv. Consolidation and Closures

More California facilities will consolidate or close in response to the oversupply of hospital beds and declining inpatient volumes.

- Health care providers are restructuring through mergers and acquisitions to obtain operational efficiencies gained through economies of scale. Hospital networks also help attract a reliable stream of patients and offer access to capital from investors.
  - HMO consolidation will leave four to five dominant managed care organizations with more than 75 percent of the California market, according to *California Healthcare 1999-2005*. For example, Columbia and HCA merged to become the largest health care chain in the US, operating over 200 hospitals.
  - A growing phenomenon in the industry is the formation of Integrated Delivery Systems (IDS), where two or more industry segments (e.g., hospitals, physicians, managed care plans) combine to increase efficiency through the streamlining of primarily financial and managerial functions.[8]
- According to a 1998 Deloitte & Touche Survey, only 34 percent of surveyed hospitals expect to be stand-alone, independent facilities in 2003, as compared to 58 percent in 1998.
- Despite consolidation activity, the industry is still overbuilt; industry sources estimate the oversupply of beds at 40 percent.[9] Overcapacity and low occupancy continue to force hospital chains to rationalize assets. Tenet Health, the #2 US hospital chain, is divesting facilities to cut costs.

These industry trends set the stage for the following discussion of the California health care industry's needs and wants.

---

[8] Bureau of Labor Statistics, *Occupational Outlook Handbook 2000-2001*, Health Services; see also Standard & Poor's

[9] Standard & Poor's, p. 14

III. Needs and Wants

A. Overview

Containing costs and meeting regulatory requirements — especially seismic safety standards — top the California health care industry's needs and wants.

- Cost containment measures — in the areas of labor, energy and medical supplies — are needed in the current healthcare economic environment.
- While workshop participants acknowledged that heavy regulations are part of the cost of doing business, California hospitals are struggling with the financial burden imposed by seismic compliance.

Exhibit E-2
Summary of Industry-specific Needs and Wants
Hospital Industry

Industry Segments	Industry-specific Needs and Wants									
	Market				Technical				Regulatory	
	Be a Low-Cost Provider	Expand Manufacturing Operations	Manage Financial Risks	Re-establish Market Niche	Obtain Reliable Infrastructure Supply	Avoid Process Interruption	Enhance Productivity	Enhance Flexibility of Production Facilities	Helps Mitigate Regulatory Burdens, Constraints	Seismic Retrofitting Assistance
Semiconductor										
R&D facilities		◒				●	●	◒	◒	
Fabs		◒				●	●	◒	◒	
Foundries	◒	◒				●	●	◒	◒	
Equipment suppliers (toolmakers)		◒				◒	◒			
Biotechnology										
R&D facilities			●		●	◒		◒	◒	
Production facilities	○	●	●		●	●		◒	◒	
Aerospace										
R&D and New Technology Development	◒		◒	●	●				●	
Assembly	●		◒	●	●				●	
Fruit and Vegetable Processing	●		●		●		◒		●	
Hospitals	●		◒		◒	◒			●	●

KEY
Importance
● High
◒ Moderate
○ Low

III.B. Market

i. Be a Low Cost Provider

The health care industry must develop new ways to address the next round of cost-reduction pressures because some of the "easy" savings — consolidation, integrated delivery systems, and outpatient care — have been captured. [10]

- According to workshop participants, payors view health care as a commodity — hospital revenues are largely fixed under managed care — forcing hospitals to compete on price and making cost savings critical to success.
  - Major savings opportunities have already been captured through consolidation and economies of scale, and workshop participants expect future cost reductions will be more difficult to achieve.
  - Some hospitals have captured the "easy "energy savings from lighting conservation programs (electronic ballasts; T-8 lamps; light-emitting diode exit signs, occupancy sensors), high efficiency motor replacement projects (switching to variable frequency motor controls), and the installation of on-site generation facilities.

[10] Workshop participants may be on the leading edge in terms of energy savings (i.e. energy management systems, lighting controls), but savings have not been achieved across the board in California. There is room for more energy savings in smaller hospitals as well as networks.

III.B.i.a. Labor

Labor costs typically account for about 40 to 50 percent of hospital operating costs, according to Standard and Poor's 2000 industry survey.

- Although California hospitals are subject to minimum staff requirements, such as minimum nurse-to-patient ratios that will take effect in 2002, there are opportunities for further cost reductions.[11]

- Hospitals increasingly rely on registered nurse practitioners (RNPs, who are licensed to prescribe medication) and physicians assistants to reduce labor costs. RNPs diagnose and treat common acute illnesses and injuries and prescribe medications. According to workshop participants, these caregivers do all of the prep and leave only the essentials to the physician.

- Workshop participants fear a shortage of physicians and nurses in the future.

  – California ranks last among the 50 states in the proportion of registered nurses (RNs) per state resident, according to the California Health Association.

  – The average age of the nursing workforce is 45, according to participants.

  – Hospital nursing is the most difficult, unpleasant nursing work, according to workshop participants.

Workshop participants fear an impending nursing shortage will drive up hospitals' biggest cost — labor.

[11] California Healthcare Association, *CHA Special Report*, April 2000.

III.B.i.b. Non-Energy Operating Costs

Non-energy operating costs can be reduced through outsourcing, standardization and purchasing pools.

- Hotel (housekeeping, food and nutrition service) and support services (engineering, environmental, maintenance, biomedical) are typically outsourced, according to workshop participants.
  - Some hospitals have outsourced technical laboratory tasks to larger, centralized laboratories to save money.
  - Other hospitals enter purchasing pools to obtain deeply discounted supply contracts.
- Networks participate in system-wide materials management processes that offer standard contracts and a streamlined process for selecting and utilizing common clinical products.
- Hospitals realize substantial cost savings and efficiencies through standardization, largely by reducing different types of supplies and equipment.

III.B.i.c. Energy

Workshop participants discussed areas of energy use that utility programs could potentially address beyond the "easy" energy savings that many hospitals have captured.

- With respect to future energy savings opportunities, participants discussed the following:
  - In a deregulated market, workshop participants see flatter load shapes as the key to being an attractive customer for an entrepreneurial power supplier.
  - Hospitals want the option to use more than one type of fuel when future on-site generation facilities are redesigned.
  - While a representative from one HMO saw submetering as valuable, other participants observed that BTUs per square foot was fairly consistent across all hospitals.
  - Participants do not see thermal energy storage (TES) systems as cost effective unless a huge rebate is involved. TES also presents space challenges.
- Participants expressed interest in using hospitals' backup generation assets to ease demand shortages during peak periods.
- Power quality was not on the workshop participants' radar screens at all, despite hospitals' need for reliable, uninterruptible source of power. Workshop participants mentioned unsubstantiated rumors that power spikes have affected equipment, but pointed out that most critical areas are backed up, so rolling blackouts do not affect hospitals as much as they affect other industry segments.
- Furthermore, according to workshop participants, hospitals have no metrics (energy costs per square foot) for facility designers; there are no benchmarking practices.
- According to participants, "bedless hospitals" — surgery centers, medical office buildings and freestanding outpatient facilities — that house sophisticated medical equipment are becoming more energy intensive.

- In addition, energy efficient solutions may be sometimes ignored because plant engineers have failed to articulate the business case for those solutions to corporate decision-makers; language and status issues may impede effective communication.

III.C. Regulatory

The health care industry operates in a "byzantine" regulatory environment, according to workshop participants.

- The industry is highly regulated by a diverse set of agencies — 250 and counting — according to participants. For example, mobile MRIs are regulated by the California Department of Transportation.

- Workshop participants observed that public pressures drive government intervention, such as the move towards expanding prescription drug coverage for seniors. One participant pointed to the uninsured as the next big health care issue. As public concern with the gap in access to quality health care rises, government may step in to address the issue. Such regulatory and political developments could increase healthcare industry costs, squeeze hospitals' margins and hinder their long term planning.

III.C.i. Seismic Retrofitting Assistance

An estimated $24 billion for retrofits and new construction will be needed to bring California hospitals into compliance with new seismic safety requirements.

- The California legislature passed SB 1953 after the structural and nonstructural (mechanical, electrical and plumbing systems) damage hospitals experienced from the January 1994 Northridge earthquake. SB 1953 requires California hospitals meet new seismic standards by 2002, 2008 and 2030 (see glossary for details).

- Original cost estimates to bring California hospitals into compliance with SB 1953 were at least $14 billion. According to workshop participants, costs are now estimated to be at least $24 billion because most hospital buildings cannot be brought into compliance through retrofit investments; they must be rebuilt.

- Barriers to compliance include:

  – Access to capital: The cost of repair exceeds the market value of all existing California hospitals, according to the California Healthcare Association.

  – Labor: Some industry observers argue that there are not enough architects, engineers and builders in California to bring hospitals into compliance by the deadline. One strategy is to keep old facilities open as clinics, which are not subject to the seismic retrofit law.

- The California legislature may consider financial assistance (in the form of grants, loan guarantees, or state bonds), seeking FEMA funds, relaxing seismic standards and extending the deadline to make compliance financially feasible.

Seismic regulations present an area of opportunity for utilities to strategically engage the health care industry in meeting long-term construction and retrofitting needs. This concept is discussed further in the recommendations section.

III.C.ii. Standardization

According to participants, standardized building practices could significantly reduce the cost of hospital construction.

- A packaged design template would offer significant cost savings. One participant suggested designing one hospital and building it 100 times.
- Despite potential cost advantages, there is a complete lack of standardization in the health care industry because:
  - Current building codes inhibit standard design templates. Standardization is difficult due to conflicting codes, different inspection standards and ambiguous agency purview.
  - It would be difficult to template an entire hospital because hospitals have different product lines and core competencies, but certain areas (such as energy requirements, materials and finishes) can be standardized, according to participants.
- In spite of these challenges, Kaiser developed internally consistent building standards: their Gateway templates and Templates 2000.
- Conflicting codes (National Fire Protection Association contrasted with the local Uniform Building Code) present a tremendous dilemma because hospitals cannot meet both in building new facilities, according to workshop participants.
- Workshop participants noted the flexibility of the "dot com" construction model. Internet companies design buildings with a short time horizon in mind, expecting to vacate the newly constructed building due to industry volatility. These buildings can quickly change from an office to a laboratory or be used for some other function. According to participants, central plants are modular; larger pumps can easily replace existing pumps.

Opportunities for utilities to meet the needs of their health care industry customers are discussed in the next section.

IV. Program Strategies

A. Overview

There are some opportunities for California's utilities to assist its large health care industry customers in meeting their cost containment and regulatory needs. Energy savings may be one of the few win-win opportunities available to hospital cost cutters, but utilities will have to develop new options because some hospital facility managers and their ESCO partners have already captured savings from low-hanging fruit, such as lighting retrofits and motors change-outs.[12]

- Programs that achieve energy and demand savings without compromising quality of patient care would be appealing to hospital decision makers. Examples include:
  - Improving hospitals' load factor through load management incentives, load leveling opportunities, and submetering.
  - Holding workshops to update CFOs on opportunities for energy and demand savings.
  - Facilitating communication between energy / facility managers and CFOs regarding savings potential.
- Utilities can work with the health care industry in its retrofitting and long-term construction projects to comply with seismic standards in ways that are beneficial both to the utilities and the health care industry.
  - Finance engineering studies and demonstration projects, especially in small community and rural hospitals.
  - Work with engineers and architects upstream in the design / build process.
  - Help develop standard designs for energy-efficient central plants.
  - Fund central plant construction retrofits as demonstrations.
- Building commissioning offers a way to address hospitals' concern with the bottom line as they build new facilities and retrofit old ones.

Each of these is discussed in detail on the following pages.

[12] Workshop participants may be on the leading edge in terms of energy savings (i.e. energy management systems, lighting controls), but savings have not been achieved across the board in California. There is room for more energy savings in smaller hospitals as well as networks.

Exhibit E-3
Hospital Industry Needs and Wants Program Selection Matrix

Recommendations	Selection Criteria: Industry Related Needs and Wants — Market: Be a Low-Cost Provider	Market: Expand Manufacturing Operations	Market: Manage Financial Risks	Market: Re-establish Market Niche	Technical: Obtain Reliable Infrastructure Supply	Technical: Avoid Process Interruption	Technical: Enhance Productivity	Technical: Enhance Flexibility of Production Facilities	Regulatory: Mitigate Regulatory Burdens, Constraints	Regulatory: Seismic Retrofitting Assistance
INCREASE ENERGY EFFICIENCY OF FACILITIES										
Support ESCO Activities Attuned to Industry Needs	●				●					
Streamline SPC Process	●								◒	
Educate Facility Managers re Business Case Presentations	◒									
Support Building Commissioning	●									●
Support Open Architecture for Metering, Submetering	○									◒
ENHANCE PRODUCTIVITY AND EFFICIENCY										
R&D Collaboration										
Industry-specific Demonstrations and Case Studies										●
Design Assistance										●
BUILD COOPERATIVE RELATIONSHIPS										
Partnerships between Industries and Utilities	◒				●				●	
COMPETITIVE TRANSITION ASSISTANCE										
Advice to Industry about California Energy Market	●		◒		●				●	
Financial Instruments to Manage Energy Price Risks	●		◒		●				●	
INCREASE ENERGY RELIABILITY										
Load Management	●									●
Funding for Distributed Generation and Cogeneration	●									●

KEY
Relevance
● High
◒ Medium
○ Low

IV.B. Increase Energy Efficiency of Facilities

i. Contacts with CFOs and Facilities Engineers

Utility representatives could educate hospital management on energy and demand savings through workshops and demonstrations.

- Though energy is often the third- or fourth-largest enterprise cost, a 1998 survey by CFO Magazine reports that financial decision-makers consider energy to be their least controllable business expense.
- CFO workshops may be used to increase the level of awareness regarding energy cost management issues and update financial decision makers on opportunities and methods (i.e., load profiles, real time pricing, monitoring enhancements, equipment upgrades, operational adjustments) to reduce bottom line electrical energy costs.
  - Even a one percent savings is important to CFOs, who are looking for any worthwhile technical opportunities, because of thin profit margins.
  - Corporate decisions in hospital chains may be made outside the state of California.
- Utilities can conduct workshops and demonstration projects and produce case study reports written for facility managers on making the business case for energy savings potential to CFOs.

IV.B.ii. Building Commissioning

Impending hospital construction and seismic retrofitting presents an opportunity for building commissioning, which helps hospitals control operating costs.

- Building commissioning and retrocommissioning is a way to systematically optimize building systems, as new hospitals are built and older ones retrofitted to comply with California seismic standards.
- Commissioning can help hospitals to minimize life-cycle costs by changing O&M practices. Commissioning reduces operation, maintenance and equipment replacement costs.
- Utilities can encourage hospitals to reinvest in more cost efficient energy-saving building systems through incentives to offset the first cost of building commissioning.

Utilities should be involved in new hospital construction and retrofitting projects from the early design phase to the final commissioning, which is discussed next.

IV.C. Enhance Productivity and Efficiency

i. Seismic Retrofitting Assistance

Utilities could help the California health care industry design hospitals that are energy efficient as well as seismically safe.

- Utilities should be involved in the design phase to maximize efficiencies.
  - Utilities can partner with engineers and architects upstream in the design/build process to facilitate standardized, energy efficient design.
  - Utilities can help develop standard designs for energy-efficient central plants that meet hospitals' major needs for flexibility of use, openness, multiple fuel types and backup generation. Modular designs would relieve the initial cost and staff burden in meeting new seismic standards, and address workshop participants' interest in templating and creating energy savings. Funding central plant construction retrofits as demonstrations would be useful in this effort.
  - Utilities could collaborate with regulators as well as the health care industry in standardizing energy-related design and construction projects. Utilities, engineers and builders could promote new energy-efficiency and construction ideas to the Office of Statewide Health Planning and Development (OSHPD) and other regulators as seismic retrofitting moves forward.
- Utilities should also encourage efficient equipment to be installed in new facilities and seismic retrofits.
- Other possible programs for facilitating seismic upgrades suggested by workshop participants include financing engineering studies, especially in small community and rural hospitals that don't have easy access to capital from investors.

IV.D. Increase Energy Reliability

i. Funding for Distributed Generation and Cogeneration

Utilities could help hospitals improve their load factor through load management initiatives and load leveling. Opportunities include:

- Working with hospitals to leverage their distributed generation capabilities by offering load management incentives. Workshop participants expressed interest in using their backup generation assets to ease demand shortages during peak periods, indicating that some hospitals would be receptive to such a load management initiative.

- Informing hospitals about management techniques for improving load factor, thereby reducing O&M costs.

F. DETAILED DESCRIPTIONS OF KEY STEPS

I. Specific Methods

A. Overview

Details of the key steps in the Large Customer Needs and Wants Project are presented in this appendix.

- First, an extensive literature review was conducted to incorporate lessons learned from previous research. Sources reviewed include market segment analyses, industry reports, and publications from EPRI's "Voice of the Customer" project.[1]

- Next, the findings of the literature review were used to identify business segments that should be targeted for more detailed research. Experts who were knowledgeable about these segments were recruited for intensive but informal workshops, to gather market intelligence.

- The workshop findings (i.e., information on industry context, perceived needs, and recommendations made by the industry experts) were analyzed to elaborate their implications for utility support and partnering opportunities.

- Lastly, the workshop findings and the implications of these findings were discussed with program planners, managers, and advisors.

The method used to select the industry groups included in this study is presented next.

[1] The Electric Power Research Institute (EPRI) conducted considerable customer needs research in the late 1980s and early 1990s that culminated in the development of CLASSIFY, a needs-based customer segmentation methodology and software, and a four-volume series of CLASSIFY-Profiles. See EPRI at www.epri.com.

II. Selecting Industry Groups

The initial task for the research team was to identify potential California industries for program consideration.

- The criteria used included quantitative measures such as overall segment size in the state (based on revenues and number of employees), concentration of large nonresidential customers, and annual energy purchases per establishment.

- A list of 275 California industries was constructed for which data were available. These segments were ranked, first, as a function of the number of employees, then according to sales or revenues (less labor costs, to avoid over-weighting the importance of labor). The average of these two rankings was used to give an overall measure of the relative importance of each business segment. Concentration was defined in terms of revenues per establishment within a given sector; business segments ranking higher on this criterion were considered more important for utility programs directed at large nonresidential customers considering equipment retrofits and turnovers (the study's intended focus area).

- The business segments were ordered again based on the mean ranking after including this final quantitative measure, and the top 20 segments were selected for consideration. In addition, to account for energy consumption characteristics, the top 11 segments with average annual energy purchases per establishment greater than 2 GWh were added to the list of 20 segments that were chosen as described above, resulting in a list of 31 segments that were selected for project consideration. Exhibit F-1 shows the list of the 31 highest-ranking segments based on the quantitative criteria.

Exhibit F-1
Business Segments Selected for Consideration on the Basis of Quantitative Characteristics

ID	North American Industrial Classification System (NAICS) Name
2211	Electric power generation, transmission, and distribution
3114	**Fruit and vegetable preserving and specialty food manufacturing**
3241	Petroleum and coal products manufacturing
3251	Basic chemical manufacturing
3252	Resin, synthetic rubber, and artificial and synthetic fibers and filaments manufacturing
3253	Pesticide, fertilizer, and other agricultural chemical manufacturing
3254	**Pharmaceutical and medicine manufacturing**
3255	Paint, coating, and adhesive manufacturing
3256	Soap, cleaning compound, and toilet preparation manufacturing
3259	Other chemical product manufacturing
3311	Iron and steel mills and ferroalloy manufacturing
3312	Steel product manufacturing from purchased steel
3313	Alumina and aluminum production and processing
3314	Nonferrous metal (except aluminum) production and processing
3315	Foundries
3341	Computer and peripheral equipment manufacturing
3342	Communications equipment manufacturing
3344	**Semiconductor and other electronic component manufacturing**
3345	Navigational, measuring, medical, and control instruments manufacturing
3364	**Aerospace product and parts manufacturing**
4211	Motor vehicle and motor vehicle parts and supplies wholesalers
4214	Professional and commercial equipment and supplies wholesalers
4216	Electrical goods wholesalers
4219	Miscellaneous durable goods wholesalers
4224	Grocery and related product wholesalers
4411	Automobile dealers
4521	Department stores
5112	Software publishers
5133	Telecommunications
5221	Depository credit intermediation
6221	**General medical and surgical hospitals**

II. Selecting Industry Groups (continued)

The project team and advisors then selected 5 business segments for this study on the basis of qualitative judgments regarding several issues.

- The list of 31 segments was winnowed to a list of 7 segments using the following primary criteria (based on the collective professional judgments of the research team):
  - Potential for increased energy efficiency or energy savings.
  - Industries experiencing significant growth or other substantial changes — the team attempted to take into account such factors as potential changes in export opportunities (e.g., additional trade with China) and susceptibility to other changes in the current economic environment (e.g., interest rates and the growth of the "new economy").
  - Availability of existing energy solutions from utilities — here, an effort was made to consider the utilities' potential to develop feasible initiatives with a minimum of lead-time
- Other concerns included:
  - Opportunities for utilities to develop new energy-saving solutions — an attempt was made to consider the degree to which a segment that had not been targeted in the past might offer opportunities for creative approaches.
  - Criticality of energy reliability — the degree to which the industry seems to value uninterrupted power and might be amenable to programs focused on that issue.
  - Load management opportunities — the degree to which the industry might offer utilities the opportunity to obtain load relief, given an effective, win-win program design.
  - Lack of severe practice barriers in the business segment.
  - Lack of severe practice barriers in the business segment — the degree to which the industry is perceived to be willing to consider new practices; the perceived lack of entrenched procedures and operational rigidity.

- Specific reasons for elimination of various candidates in the winnowing from 31 business segments to seven include the following:[2]

  – Wholesale industries (NAICS 42XX) appeared on the initial list because of the high value of the goods involved, but their energy intensity is low and their energy uses are uncomplicated and offer relatively little room for significant savings.

  – Automobile dealers (NAICS 4411) were eliminated for the same reasons.

  – Most raw materials processing industries (NAICS 32XX and 3311-3315) are very energy- and capital-intensive, but also tend to cogenerate power. Moreover, most have demonstrated considerable attention to energy-related issues and sophistication in dealing with those issues. Furthermore, the majority of these industries appear to be relatively stable with slow growth. The pharmaceutical industry, including biotech companies (NAICS 3254), appears to be an exception to each of these generalizations, however.

- The project team and advisors then prioritized the seven remaining segments on the basis of:

  – Geographic equity (a balance among industries concentrated in Northern California and those concentrated in Southern California).

  – Sector equity (inclusion of both commercial and industrial business segments).

  – Research feasibility (potential for producing useful results to provide input to program planning as quickly as possible).

Quantitative data for the 5 selected segments (in bold) and two alternates are provided in Exhibit F-2.

[2] These judgments were developed by the project advisory group, in consultation with in-house experts on various commercial and industrial segments at the California Energy Commission and the participating utilities. Some information was also drawn from the sources used to obtain the quantitative data.

Exhibit F-2: Criteria Values for Selected Business Segments

ID	*NORTH AMERICAN INDUSTRIAL CLASSIFICATION SYSTEM (NAICS) NAME*	Number of establish-ments	Sales, shipments, receipts, revenue ($1,000)	Annual payroll ($1,000)	Number of employees	Employees per establish-ment	Sales/ revenue less labor	Rank sales less labor	Rank number employ-ees	General size rank	Sales per establish-ment	Rank sales per establish-ment	Total rank	Class energy purchase per establish-ment (1=high, 4=low)
3114	**Fruit and vegetable preserving and specialty food manufacturing**	**329**	**9,514,062**	**1,121,392**	**43,799**	**133.1**	**$8,392,670**	**53**	**76**	**64.5**	**$28,918**	**18**	**41.25**	**2**
3254	**Pharmaceutical and medicine manufacturing**	**305**	**8,248,204**	**1,387,911**	**27,022**	**88.6**	**$6,860,293**	**60**	**107**	**83.5**	**$27,043**	**19**	**51.25**	**1**
3341	Computer and peripheral equipment manufacturing	590	35,197,306	3,731,820	68,527	116.1	$31,465,486	9	41	25	$59,656	8	**16.5**	3
3342	Communications equipment manufacturing	550	23,376,973	3,886,957	71,160	129.4	$19,490,016	22	40	31	$42,504	11	**21**	3
3344	**Semiconductor and other electronic component manufacturing**	**1677**	**30,536,457**	**6,254,547**	**140,480**	**83.8**	**$24,281,910**	**14**	**12**	**13**	**$18,209**	**29**	**21**	**3**
3364	**Aerospace product and parts manufacturing**	**343**	**22,060,118**	**5,566,864**	**102,956**	**300.2**	**$16,493,254**	**27**	**26**	**26.5**	**$64,315**	**5**	**15.75**	**3**
6221	**General medical and surgical hospitals**	**450**	**34,091,717**	**14,110,395**	**392,213**	**871.6**	**$19,981,322**	**20**	**3**	**11.5**	**$75,759**	**3**	**7.25**	**3**

Department of Commerce, 1997 (California).

III. Workshops

A. Sample of Workshop Participants

Workshops for three of the five industries selected were conducted during the summer of 2000. The final two workshops were completed in October 2000.

The universe of experts from which the sample of workshop participants was drawn includes several key sources.

- A preliminary listing of candidates was drawn from a review of recent reports and conference presentations as well as other industry sources, designed to seek a balance of representatives from:
  - Academia
  - Research laboratories conducting relevant projects
  - Companies that provide crucial services to the industry
  - Independent consultants who serve the industry
  - Associations that represent corporate industry participants or professionals in the industry
  - Media that specialize in the industry
  - Investment analysts who follow or specialize in the industry.
- Additional candidates were identified through discussions with initial contacts (thus, a "snowball sample").
- Personal discussions were conducted with all potential participants to ensure their expertise, relevance, and interest.

A list of the individuals who participated in the workshops is presented in Appendix G.

III.B. Panel Selection

Recruitment of the panel participants stressed the opportunity to meet with other experts and the potential contribution of the workshop to the industry.

- The number of experts involved was capped at seven, to ensure full participation by all attendees throughout the discussions.
- Written communications included a formal letter of invitation describing the purpose of the project, a preliminary agenda, and a discussion of the meeting logistics (including the maintenance of an informal discussion atmosphere).
- Honoraria were provided, but most experts agreed to participate even before the remuneration was offered.
- The most pressing concerns of the participants were the bona fides of the sponsor and the workshop facilitator, the uses to which the information would be put, and by whom.

III.C. Workshop Process

The workshop process was designed to move from a broad overview of the industry to its general needs and wants and, ultimately, to the implication of these needs and wants for its energy-related product and purchase decisions in an informal, collegial atmosphere.

- After the industry experts were recruited for each industry segment, one-day workshops were conducted to gather relevant information.[3] These sessions were intensive, informal, facilitated discussions that focused on current market trends, industry background and context, future expectations, general needs and wants, energy-related needs of the industry, and, lastly, recommendations for utility action. The central findings of each workshop led to specific recommendations for possible program initiatives for the utilities.

  – The process was somewhat similar to that of a focus group — facilitated; highly interactive; and avoided leading questions.

  – The facilitator was responsible for ensuring coverage of the various agenda topics and eliciting clarification of technical points.

  – Each of the experts contributed generously and in depth. The contribution of background material was encouraged, while formal presentations were discouraged.

- Great care was taken to promise confidentiality where appropriate and ensure participants that it was neither our intent nor our objective to inquire about or divulge proprietary information. These reassurances were made during the recruitment process and were re-emphasized at the start of the workshop discussion. Since the workshops were taped to aid in writing the study report, participants were given the freedom to stop the recorder at any time. Opportunities for private discussions, in the absence of workshop facilitators, were also provided.

[3] The groups met for dinner on the eve of the workshop, to get acquainted (or, in some cases, to catch up with one another) and eliminate any need for formalities the following day.

- Finally, participants were given the opportunity to review the draft of the workshop report, in order to comment on the report and to verify that we were reporting their comments and recommendations accurately.

IV. Analysis Methods

The information gathered from the workshops was used to develop a market assessment and characterize each industry segment. This characterization is a key element of the study in that it sets the context for the recommendations made by workshop participants and those made by the consultants for potential energy efficiency programs.

Background research, workshop findings, and supplementary materials were compiled to make both general and specific program recommendations, which were reported to program planners.

- The key to the success of this project was a careful assessment of the workshop findings and recommendations that identified feasible utility actions that are based on the strategic concerns of a particular industry segment. This was accomplished by first matching utility priorities with industry priorities, and then determining practical responses for the utilities. These alternatives were then rank-ordered, based on estimates of energy savings, cost-effectiveness, and customer participation. Exhibit F-3 illustrates a tool that was used in accomplishing the objective of developing feasible utility actions based on the workshop findings. Specifically, this matrix is used to match industry and utility priorities, which is necessary to successfully identify potential program opportunities.

  – Using a three-point scale (low, medium, high), workshop recommendations can be evaluated on their relevance to each industry- and utility-related objective. The recommendations that have the highest overall ranking denote those which best meet the strategic goals of both the industry and the utility; these would be selected as potential program opportunities.

Exhibit F-3, Draft Selection Matrix

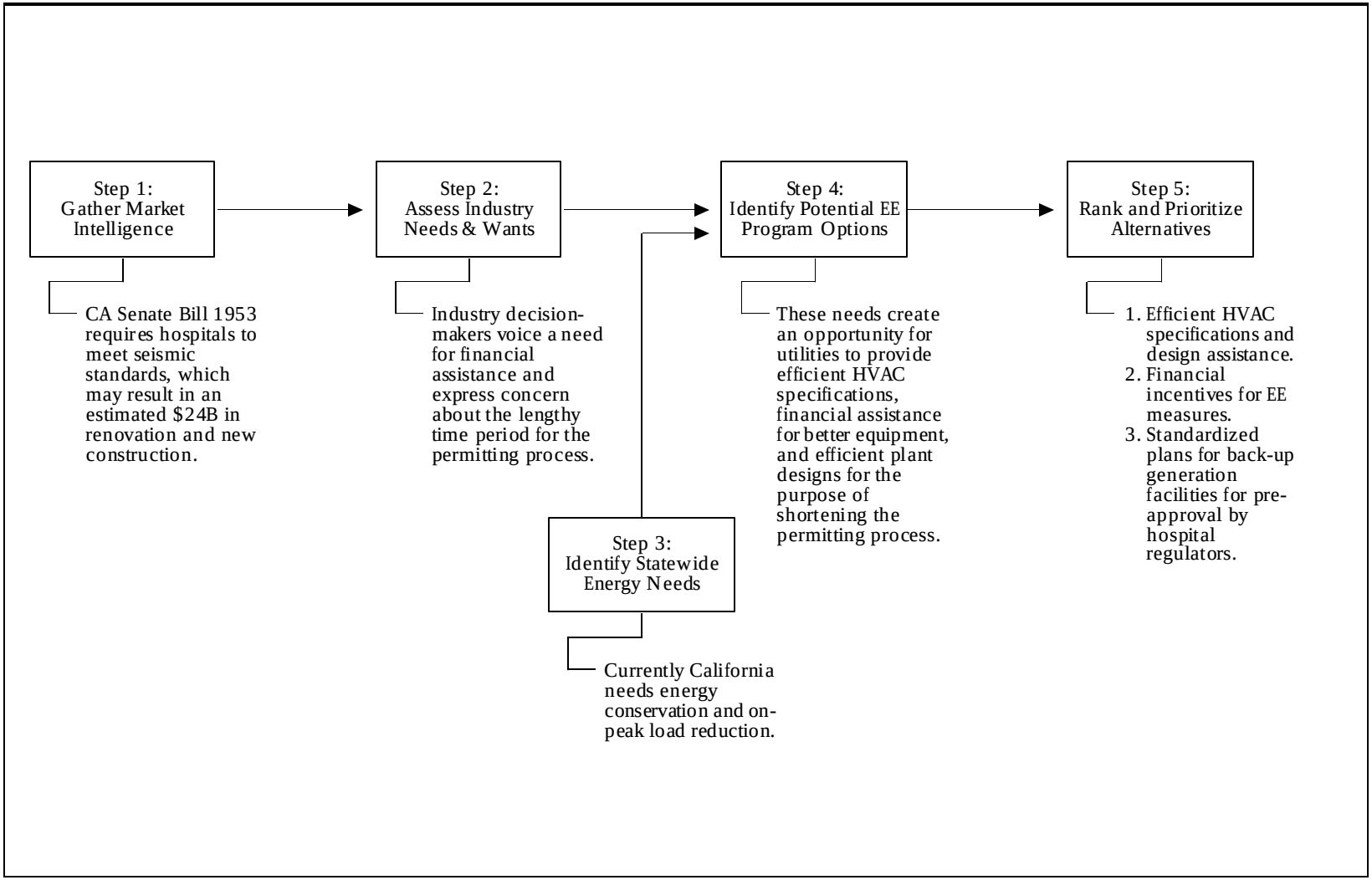
Recommendations	Selection Criteria										
	Industry-related						IOU-related				
	Contributes to speed of production	Avoids interruption of processes	Likely to improve yield, maintain quality	Applicable to semiconductor industry	Pre-competitive	Other non-energy benefits	Feasible for implementation in PY2001	Can be applied across several sectors	Cost-effective	Other	Other
Executive-executive contacts											
Cooperation with organizations in the semiconductor industry											
Partnerships with toolmakers											
Utility leasing of tools											
Support and extension of tool refinement											
Facilitation of economic model development											
Investment in demonstrations											
Publication of case studies											
Financial assistance for monitoring equipment											
Education of facility managers re business case presentation											
ESCO development and support											
Specialized task forces											
Cooperative relationships with related organizations											
Other (A)											
(B)											
(C)											
(D)											

- After program planners identify the recommendations that appear to have the greatest potential for success, they will want to consider relevant implication issues such as timing, budgetary requirements, and program delivery issues. Then, each feasible recommendation can be prioritized based on these factors, and on the criteria listed above.

  – Exhibit F-4 diagrams the process for developing program recommendations, which derive directly from the needs and wants expressed by industry insiders and commentators. To develop feasible utility programs, planners must gather market intelligence, assess industry needs and wants, compare them to energy-related needs, identify potential utility responses, and then rank and prioritize alternative recommendations.

  – Consider an example, which focuses on the case for hospitals with regard to California Senate Bill 1953 (CA SB1953). The requirements of this legislation have created the need for massive investment in upgrading hospitals or building new ones. This opens up the opportunity for utilities to assist hospital decision-makers and designers with compliant, energy-efficient HVAC design options, financing assistance, and possible assistance in getting through the permitting process. The key is that the program options shown in Step 4 are developed directly from an analysis of the market intelligence that was gathered in Step 1.

Exhibit F-4
Process for Developing Program Recommendations



G. LIST OF WORKSHOP ATTENDEES

Semiconductor Industry Workshop Attendees

Name	Organization (for identification purposes only)[1]
Ron Chiarello	Stanford University
Tom Huang	Sematech
Chris Robertson	Chris Robertson & Associates
John Rosenblum	Rosenblum Environmental Engineering
Peter Rumsey	Supersymmetry
Mitchell Swann	Day & Zimmermann Life Sciences International
Bill Tschudi	Lawrence Berkeley Laboratory

[1] Throughout the discussions, workshop attendees participated as individuals. They did not represent their organizations, the viewpoints of their organizations, or the viewpoints of any project or research sponsors of those organizations.

Biotech Industry Workshop Attendees

Name	**Organization (for identification purposes only)[2]**
Dr. David Gollaher	California Healthcare Institute
Andrew Scherer	Genentech
Dr. Shauna Farr-Jones	BioCentury
Dr. Paula Szoka	University of California, Technology Transfer Office
Al DeGroot	Chiron
Pete Herold	Burnham Cancer Institute

[2] Andrew Scherer and Al DeGroot were unable to attend the workshop; follow-up phone interviews were conducted with each.

Aerospace Industry Workshop Attendees

Name	Organization (for identification purposes only)
John Bass	John Bass and Associates
Jim Gifford	Northrop Grumman
Geoff Gosling	University of California, Berkeley, Institute of Transportation Studies
Chris Hoeber	Space Systems / Loral
Carl Nordquist	Boeing (Space and Communication)
Richard Robertson	Lockheed Martin

Preserved Fruit and Vegetable Industry Workshop Attendees

Name	Organization (for identification purposes only)
Diane Barrett	University of California, Food Science and Technology
Kebede Gashaw	The Morning Star Company
Paul Fanelli	Patterson Frozen Foods
Glen Lewis	Del Monte
Ed Yates	California League of Food Processors

Health care industry Workshop Attendees

Name	Organization (for identification purposes only)[3]
John Cochran II	All Health, Healthcare Association of Southern California
David Grazman	School of Policy, Planning and Development, University of Southern California
Bob Reed	Sutter Health
William Vogt	H. John Heinz III School of Policy and Management, Carnegie Mellon University
Bill Rostenberg	Smith Group
Fred Osborne	Osborne Engineering, Inc (Joint Commission on Accreditation of Healthcare Organizations)
Rich Seguin	Kaiser Permanente National Facility Services

[3] Throughout the discussions, workshop attendees participated as individuals. They did not represent their organizations, the viewpoints of their organizations, or the viewpoints of any project or research sponsors of those organizations.

H. GLOSSARY

Burn rate. The rate at which a new company uses up its venture capital to finance overhead before generating positive cash flow from operations - or how much cash is necessary to keep the business operating from month to month. It is the rate of negative cash flow, usually quoted as a monthly rate. Burn rate is generally used in terms of cash spent per month. A burn rate of 1 million would mean the company is spending $1 million per month. When the burn rate begins to exceed plans or revenue fails to meet expectations, the usual recourse is to reduce the burn rate (which, in most companies, means reducing the staff). Burn rate is a widely observed, critical measure of a company's longevity.

Capitation. Under capitation, providers -- hospitals and/or physicians -- agree to accept a set advance payment in exchange for providing health care services for a group of people, usually for a year. Hospitals and/or physicians receive payments per member per month for a comprehensive set of services, or for a more specialized service, such as cardiac care. Whether a member uses the health service once or a dozen times, a provider who is capitated receives the same payment.

Clean room. A controlled environment for manufacturing, in which air temperature, humidity level, and particulate matter are strictly controlled through sophisticated HVAC and air filtration systems.

Consumables are products required for processing materials in order to manufacture an item; e.g., lubricants, acids, cleaning solvents.

Cost Shifting. (1) When the cost of uncompensated care provided to the uninsured is passed on to the insured. (2) Increasing revenues from some payers to offset losses and lower net payments from other payers.

Deionized/reverse osmosis. Removes dissolved salt by forcing water through a membrane at high pressure, resulting in 2 water streams - a deionized, clean stream and a wastewater stream.

Feedstock are raw materials that comprise the elements of a manufactured item; e.g., copper wire, adhesives, plastic sheeting.

Health Maintenance Organization (HMO). The most popular health plan structure in California, HMO members receive comprehensive preventive and hospital and medical care from specific medical providers who receive a pre-paid (capitated) fee. Members select a primary care physician or medical group from the HMO's list of

affiliated doctors. In turn, primary care doctors coordinate the patient's total care, which is free from hassles involving deductibles or claim forms. When using medical services, members pay a small co-payment, usually between $5 and $15.

Integrated circuit (IC) chip or microchip is a semiconductor wafer on which thousands or millions of tiny resistors, capacitors, and transistors are fabricated. An IC can function as an amplifier, oscillator, timer, counter, computer memory, or microprocessor. A particular IC is categorized as either linear (analog) or digital, depending on its intended application. (http://www.whatis.com)

Integrated Delivery Systems (IDS). An entity that usually includes a hospital, a large medical group, and an insurance vehicle such as an HMO. Typically, all provider revenues flow through the organization. This linkage of all regional services — vertical and horizontal — into one legal entity enables the organization to negotiate with the marketplace. In its most integrated form, an IDS even includes an insurance or financing function, so that there is no division between provider and payer.

Irradiation is exposure of food to sufficient radiant energy (gamma rays, x-rays and electron beams) to destroy microorganisms and insects. Irradiation is used in food production and processing to promote food safety.

Lithography is a sophisticated etching process by which circuitry is "printed" onto a chip.

Medicaid. A Federal Program that pays for the health services of certain groups of people — the poor who are blind, aged, disabled or members of families with dependent children. Subject to broad Federal guidelines, states determine the benefits covered, program eligibility, rates of payment for providers, and methods of administering the program.

Medicare. Title XVIII of the Social Security Act, which provides payment for medical and health services to the population aged 65 and over regardless of income, as well as certain disabled persons and persons with ESRD.

Medi-Cal. This is California's version of the Medicaid program.

"Moore's Law" is an historical observation by Intel executive, Gordon Moore, that the market demand (and semiconductor industry response) for functionality per chip (bits, transistors) doubles every 1.5-2 years. (ITRS, p. 17)

Multi-stage air filtration is a sophisticated filtration process required to remove particulate matter from air before delivering it to clean rooms.

Network. A group of health care providers (physicians, hospitals and other providers) under contract with a managed care company within a specific geographic area.

Ohmic heating results from the flow of current through a medium with electrical resistance. In plasmas subjected to ohmic heating, ions are heated almost entirely by transfer of energy from the hotter, more mobile electrons.

High intensity **pulsed electric field** (PEF) processing is a method of non-thermal food preservation that involves the application of pulses of high voltage (typically 20 - 80 kV / cm) to foods placed between 2 electrodes. PEF treatment is conducted at ambient, sub-ambient, or slightly above ambient temperature for less than 1 s, and energy loss due to heating of foods is minimized.

Registered Nurses (RN's). Registered nurses are responsible for carrying out the physician's instructions. They supervise practical nurses and other auxiliary personnel who perform routine care and treatment of patients. Registered nurses provide nursing care to patients or perform specialized duties in a variety of settings from hospital and clinics to schools and public health departments. A license to practice nursing is required in all states. For licensure as a registered nurse (RN), an applicant must have graduated from a school of nursing approved by the state board for nursing and have passed a state board examination.

Registered Nurse Practitioner (RNP). A registered nurse qualified and specially trained to provide primary care, including primary health care in homes and in ambulatory care facilities, long-term care facilities, and other health care institutions. Nurse practitioners generally function under the supervision of a physician but not necessarily in his or her presence. They are usually salaried rather than reimbursed on a fee-for-service basis, although the supervising physician may receive fee-for-service reimbursement for their services. RNPs are also considered "midlevel practitioners."

SB 1953. **Hospital Facilities Seismic Safety Act.**

January 1, 2001 - All general acute-care inpatient hospital buildings must be evaluated and placed into one of five structural performance categories (SPCs) and one of five nonstructural performance categories (NPCs). For both SPCs and NPCs, Category 1 represents "worst" and Category 5 represents "best."

January 1, 2002 - All general, acute-care inpatient hospital buildings must meet NPC-2 requirements and install brace systems for communications, emergency power, bulk medical gas, fire alarms and exit lighting.

January 1, 2008 - All general acute-care inpatient hospital buildings must meet at least SPC-2 and NPC-3 requirements so as not to pose a risk of collapsing in a major earthquake. Meeting these requirements will enable hospital buildings to remain operational from 2008 through 2030.

Nonstructural mechanical, electrical and plumbing systems, including fire sprinkler branch lines, must be braced and anchored in critical-care areas such as surgery, intensive care, pharmacy, central supply, emergency and radiology.

Rural hospitals in Seismic Zone 3 have until 2013 to brace fire sprinkler branch lines.

Delays in meeting the 2008 deadline may be granted by the Office of Statewide Health Planning and Development (OSHPD) in one-year increments for up to five years. To request a delay, hospitals must demonstrate that compliance is not attainable by 2008 and would result in a loss of capacity not provided by other general acute-care hospitals within reasonable proximity.

(NOTE: This may assist hospitals that require a short-term extension. However, it would be difficult to obtain financing based on the fact that a partially retrofitted or new hospital building may not receive an extension after a given year.)

January 1, 2030 - All general acute-care inpatient buildings must be in substantial compliance with the Hospital Facilities Seismic Safety Act. These buildings must be classified as SPC-3, 4 or 5 and NPC-5.

Semiconductor. A substance, usually a solid chemical element or compound, that can conduct electricity under some conditions but not others, making it a good medium for the control of electrical current. Its conductance varies depending on the current or voltage applied to a control electrode, or on the intensity of irradiation by infrared (IR), visible light, ultraviolet (UV), or X rays. Elemental semiconductors include antimony, arsenic, boron,

carbon, germanium, selenium, silicon, sulfur, and tellurium. Silicon is the best known of these, forming the basis of most integrated circuits (ICs). (http://www.whatis.com)

Silicon Crystals are the basic building block from which semiconductor chips are made. Silicon crystals are "grown" in furnaces where temperature is strictly controlled to enhance the crystallization of molten silicon.

Survival Index provides a method for estimating how long it will take a company to exhaust its cash reserves based on its expenditure rate. The survival index measures how long, in years, a company can last on its existing cash.

Ultra-pure water has been filtered to remove all chemical and particulate pollutants. Ultra-pure water is used as a consumable in the manufacturing of semiconductor chips.

Wafers are thin cross-sectional slices of silicon crystal, and are cut to produce round flat wafers from which silicon chips are made. Recently, the standard chip diameter has been 200 mm; however, the industry is beginning to move to a 300 mm standard.

I. BIBLIOGRAPHY

Appendix I. Bibliography

Bacheldor, Beth. "IT: Always in Good Taste," *Information Week*, September 11, 2000, www.informationweek.com/803/food.htm.

Bender, Richard H., "Benchmark Costs for Pharmaceutical Facilities," *Pharmaceutical Engineering,* 1996.

Boone, Rolf, "Seattle Labs Face Severe Space Shortage," Localbusiness.com, August 28, 2000.

BIOCOM, "Biotech Down Under," www.BIOCOM.org.

Bureau of Labor Statistics, *Occupational Outlook Handbook 2000-2001*, Health Services.

California Employment Development Department, State of California, *Biotechnology*, California Occupational Guide Number 2007 (1996), www.calmis.ca.gov/file/occguide/biotech.htm.

California Healthcare Association, *CHA Special Report*, April 2000.

California Healthcare Association. *California Health Care 1999-2005: View of the Future,* 2000.

California Healthcare Institute, "California Healthcare Institute Millennium Report: Report on California's Biomedical R & D Industry; www.chi.org/chi_2000.html.

California Institute of Food and Agricultural Research. "Survey of Energy Management in the California Food Processing Industry," UC Davis: College of Agricultural and Environmental Sciences, 1999.

California Space and Technology Alliance. *California and the New Space Services Age.*

California Trade and Commerce Agency, Office of Economic Research. "The California Food Processing Industry," Sacramento, CA., 2000.

Civil Engineering Research Foundation. "Clean Technologies in U.S. Industries: Focus on Food Processing," www.usaep.org/reports/food.htm.

CNN, "Genome Announcement a 'Technological Triumph,' June 26, 2000, www.cnn.com/2000/HEALTH/06/26/human.genome.04.

Devol, Ross, "Biotech and Bioscience: The 21st Century Cluster Race." The Zone News, January 2000, www.zonecommunications.com/jan00/biotechscience.html.

Drayse, Mark, Daniel Flaming et al. *South Bay Economic Adjustment Strategy*, Los Angeles: Economic Roundtable, http://home.earthlink.net/~economicrt/Summaries/SBEAS.html, 1998.

Economic Development Alliance for Business. "1997-2002 Strategic Plan," www.edab.org/hold/strategic1.html, 1996.

Electric Power Research Institute (EPRI). *CLASSIFY-Profiles Volume 2: Commercial and Industrial Customer Needs and Energy Decision Making*, Palo Alto: Electric Power Research Institute, 1995

Ernst & Young, *Biotech 96: Pursuing Sustainability*. San Francisco: Ernst & Young, 1996.

Ernst & Young, *The Economic Contributions of the Biotechnology Industry to the US Economy*, May 2000.

Feldbaum, Carl B., "Price Controls Could be Lethal to Biotech," *The Boston Globe*, April 20, 1999.

Flores, Rolando A., G. M. Powell, and F. M. Aramouni. "Water Supply for Food and Beverage Processing Operations," Publication MF-1122, Cooperative Extension Service, Kansas State University, Manhattan, Kansas, www.oznet.ksu.edu/dp_grsi/Flores/Resume/Extension%20Publications.htm, 1994.

Guzman, Eneida, "Cowen Analyst Says Biotech Has Come of Age," MSN MoneyCentral, April 29, 1999, www.moneycentral.msn.com/articles/invest/inter/3186.asp.

Howard, Ken, "The Bioinformatics Gold Rush," *Scientific American*, July 2000.

Koehler, Gus A., *Bioindustry: A Description of California's Bioindustry and Summary of the Public Issues Affecting Its Development*, Sacramento: California Research Bureau, 1996, www.library.ca.gov/CRB/96/07/BIOT_CH5.html#RTFToC67.

Motta, Mary. "U.S. Export Rules Chipping Away at Aerospace Firms," Space.com, http://www.space.com/businesstechnology/business/import_export_00404.html, 2000

Oversight Hearing on the Future Water Needs of California, Subcommittee on Water and Power, Committee on Resources, House of Representatives, 105th Congress, May 1, 1998.

Office of Industrial Technologies, US Department of Energy. "New Blanching System Increases Productivity while Saving Energy;" www.oit.doe.gov/nice3/projects/successes/ener2.shtml.

Panetta, Joseph, "Price Controls on Prescription Drugs — A Disincentive to Biopharmaceutical Growth," www.biocom.org/Commentary005.html.

Processed Tomato Foundation; www.tomatonet.org/processed.htm.

Rabin, Roni, "Operating in a New Realm," *Newsday*. Available http://www.future.newsday.com/2/ftop0221.htm

Schnitt, Paul. "It's time for tomatoes: The madcap harvesting season has begun, and this year's crop is forecast to be the largest ever," Sacramento Bee, California Tomato Growers Association, August 1, 1999.

Sietzen, Frank. "Red Tape Grounds Satellites," Space.com, http://www.space.com/businesstechnology/technology/selling_satellite_042800.html, 2000.

Standard & Poor's, 2000 *Biotechnology Industry Survey*.

Standard & Poor's Industry Surveys. *Aerospace and Defense*. New York: McGraw-Hill, February 17, 2000.

Standard & Poor's Industry Surveys. *Healthcare Facilities*. Vol 168, no 24, section 3. New York: McGraw-Hill, 2000.

Signals, "Financial Snapshot for October," Signals.com.

Tufts Center for the Study of Drug Development, "Maine Enacts Drug Price Controls," Impact Report, July / August 2000, www.tufts.edu / med / research / csdd / impact10.pdf.

Thornberg, Linda. "Food Processing," *Compton's Encyclopedia*, www.comptons.com / encyclopedia / ARTICLES / 0050 / 00676096_A.html, 2000.

US Census Bureau. *1997 Economic Census: Manufacturing*, Washington, DC: US Department of Commerce, 1998.

Warren, Peter M., "California and the West: State's Hospitals Face Daunting Mandate to Prepare for Quakes," *Los Angeles Times*, May 28, 2000, A1.

Wirtz Ronald A. "Concentrating on Food Concentration," *Fedgazette*, vol 12, number 1, http: / / minneapolisfed.org / pubs / fedgaz / 00-01 / food.html, January 2000.